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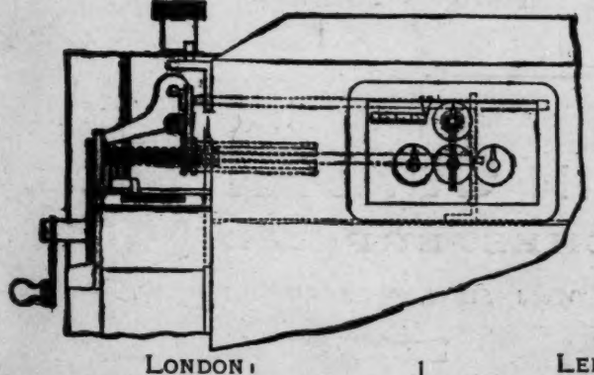
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EDITORIAL NOTES.

The New Year.

WE stand at the opening of a New Year in circumstances momentous and unprecedented. Never in history has there been a time when the wish could be more fervently expressed than now, and its consummation more devoutly hoped for, that the New Year may be a happier one nationally and for each individual than the last. This greater happiness can only be attained this year (which has begun with fresh tragic and inhumanly devised incidents) through the delivery of the world, in the complete way that this country and its gallant Allies desire, from the blasting influences of the sanguinary and destructive war. The clash of huge forces has been proceeding now (within about three weeks) for a year and a half; and no one can say how long it will be continued, although confidence reigns that organization, courage, and resolve have placed us on the high road to victory and enduring peace. We all earnestly trust the confidence is not misplaced. Great are the sacrifices that have been made; and great have been the claims upon all. And no one knows what may be the demands in the way of sacrifice that will yet be made. In these sacrifices, the gas industry has shared in common with others; in the unknown sacrifices lying before, the industry will also have to share. The greater they are, the more the industry will suffer financially through its trading. It is an industry that is largely dependent upon the prosperity of other industries and of the nation as a whole. We are constantly speaking of our prime commodity as a "necessary" of life. So it is. But if the prosperity of the country wanes, or if any extraordinary demands are made on the profits of the country's prosperity, then necessaries cannot escape the attacks of a compulsory economy. The war has schooled us to the facing of unique conditions with good resolution; and the industry will so continue to face them. But the war has done something else for our industry. It has given us new experiences, and new lessons. And these experiences and lessons must be imported into the future, and serve to direct and control future operations. From them are seen the ways to greater expansion and consolidation. The industry has used its great vitality and adaptability to shaping its course in manner compatible with the new and extraordinary conditions; and, in so doing, the limits of effective service are pushed further out. For many years the industry has been extending the territory of its service; and, in the past seventeen months, new and unexpected territory has been added within which the industry has been called upon to operate. The burden of war lies heavily upon the industry in the present in common with the rest of the country; but beyond we see the enlightenment that has come from national adversity brought to bear to the industry's lasting benefit. May the day be hastened, when, by the cessation of hostilities through positive victory, the industry may set to work upon the task of restoring its conditions and fortunes, and making use of its new opportunities. If, fortunately, this event is embraced by the year upon which we have now entered, the note of our New Year's greeting twelve months hence will be pitched in a happier key.

The Manifold Uses of Gas for Munition Making.

AN article which will at once inspire and be a source of encouragement and gratification, appears in other columns under the title of "Some Uses of Gas in the War." We have previously, through other channels, had some indication as to the large part that gas is taking in the actual production of munitions, quite apart from the supply of the vital ingredients with which certain of the munitions are fed. But in the present article, we are given—utilizing the Essex Works of Messrs. John Wright and Co., of Birmingham, as the ground of investigation—"a peep behind the "scenes," in order to see the multifarious character of the work that is being executed by the assistance of gas in the country's munitions factories. From this, there is to be derived, as we have just expressed it, a large amount of encouragement and gratification by those employed in the gas industry, because it shows that, if, under the exigencies of war requirements, the application of gas to all heating purposes for the production of munitions results in saving of space, in increased output, in enhancing control and uniformity of production, in eliminating waste, in promoting output in relation to works and labour, and in increasing works' efficiency and therefore economy, then this large group of advantages will obtain equally in times of the normal pursuit of industry and trade. But the more we penetrate into the remarkable application of gas to munitions work (no other form of heating could have been introduced so quickly), the more we feel that considerable acknowledgment is due to the makers of gas-heated furnaces and other heating equipment for the way in which they have met the extraordinary needs of the country. We pride ourselves in the gas-supply industry that it is, as a whole, working wondrously well in supplying the gas for war products and the necessaries for the making of explosives; but the manufacturers of these gas-heated appliances, large and small, for dealing with anything from brass buttons up to 15-inch shells, and even larger and weightier "articles" than these, have done their part in a manner that is beyond all praise. They stood at the entrance, so to speak, to a large part of this munitions work; and the gas suppliers and the munition workers had, on the scale at which work is now being pursued, to wait the issue of their endeavours. Output in relation to time meant much in this connection; and one cannot but be struck with what was accomplished in brief time in face of the shortage of labour and materials, and the indifferent facilities for transit. It was an immense task, which, apart from the commercial profit, was well and patriotically carried through, with, we are confident, lasting advantage to both the manufacturers of such appliances and the gas-supply industry generally. While this work has been proceeding, the manufacturers have also managed somehow—more, we believe, by excellent organization and method, than by any facilitating or adventitious conditions—to keep pace with the requirements of the gas industry for other and more ordinary goods.

Incorporated in the article are extracts from an official communication from the Director of Factory Construction in the Ministry of Munitions to the manager of every munitions factory in the country. We have before spoken of the need that there is for co-ordinating the work of the various departments engaged upon organization and provisioning for the war, as there has been abundant evidence of the counteractive effect that the prescripts and demands of one department sometimes have on the work of another. There has recently been disclosure, too, of the fact that there has not been much reciprocity shown by the Government in relation to the compliance of the gas industry with their requirements for certain supplies indispensable and really vital to the war. The official communication from the Director of Factory Construction, however, indicates that, at all events, at the Ministry of Munitions it is appreciated that, in these matters, there is interdependence and mutuality which ought to be and must be studied. Toluol, benzol, and other materials having properties essential to the manufacture of explosives are wanted in the largest possible volume; the largest possible volume cannot be obtained without the largest possible quantity of gas that can be serviceably used is consumed; and the consumption of this largest possible quantity of gas will not be attained without every munition factory putting to the utmost employment gas for the quadruple purposes of lighting, heating, cooking, and power. It is the recommendation of the Director of

Factories that this should be done; and it is being done to a very considerable extent, so much so that, in one city at any rate, the demand has been highly embarrassing. Such factories are working long hours, artificial lighting is required; they employ operatives in great number, means for cooking and warming food are required; for work, personal cleanliness, and in connection with the culinary operations, hot water is required; and in a thousand-and-one processes in connection with munitions work, heat and power are required. The opportunities for putting gas to good and advantageous use in such places are therefore great; and the more the opportunities are recognized, and recognition is followed by action, proportionately larger will become the country's resources for toluol, benzol, xylol, and other necessaries. We are pleased to observe the strong recommendation of the Director of Factories; seeing that one of the sources of material strength is the organization of work so that it is enabled to supplement national resources in respect of national essentials.

Some of the photographic reproductions accompanying the article in other columns are unique, for they have actually been taken, by permission, in factories devoted to munitions work, and they illustrate a considerable range of processes and sizes of plant in which gas is being used for supplying the needs of our Army and Navy, and of the workers in the factories. The second illustration is quite novel, as it graphically shows that in the making of a single shell—what an expenditure of shells there is day by day!—gas is required in a dozen and more of the processes contributory to the perfected article. The interest we have derived from the largely extended department at the Essex Works, Birmingham, which has been specially devoted to productions for munition work, will, we are sure, be generally shared, through the reading of the article and the study of the illustrations, by those engaged in the work of supplying the gaseous fuel for use in the types of plant referred to, and which, needless to say, are only representative, and not comprehensive, of the whole of those employed in the variegated work.

The Other Side of the Pooling Question.

The question of the pooling of privately owned railway waggons is, to all outward appearances, in abeyance at the moment; but what is happening behind doors one cannot say. There is, however, the word of Mr. Runciman that nothing shall be done in the matter without consulting the owners, who are naturally much opposed to being deprived, in meeting their obligations, of the facilities and economies with which enterprise and forethought have provided them. Mr. R. P. Wilson, in an article given in the "Iron and Coal "Trades Review," puts forward the contrary view. If we understand him rightly, there are times in which everybody should become severely altruistic, and think only of the common good, which is all very well up to a point. It is a pity that the coalowners and shipowners did not so think from the beginning of the war. But the fact stands out boldly and undeniably that they did not; and the country has since suffered very acutely from their profit-making proclivities. However, Mr. Wilson does not address himself to this aspect of the case; he confines what he has to say wholly to the one and only subject of the pooling of railway waggons. He starts on his argument with the contention that a properly organized system of pooling would go nearly the whole way towards solving the question of congestion on the railways, and winds up by saying that, if the waggons available were used to the best advantage, they would be more than ample for requirements. Therefore during the writing of the article Mr. Wilson's convictions expanded to such an extent that the capacity of the available waggons for solving the congestion problem grew from "nearly the whole way" to "more than ample." This attests an indefiniteness in the matter of data. Then this advocate of pooling says it must be remembered that trucks are primarily owned and used as a facility, and should be regarded in that light rather than as an investment. We cannot endorse this proposition as nakedly stated. The facility the trucks provide is only obtained by enterprise and investment; and the ownership acquired by investment is intended to be, and is in fact, an economic advantage which produces profit for the owners.

We come to the main point of the article, which is that the scarcity of trucks is not due to actual insufficiency, but to their terribly inadequate running. In other words, it is submitted that there is great waste of time and carrying power in the present unsystematic running, shunting, marshalling, and sorting of trucks, which, under a system of pooling, would not obtain. And what is suggested is that, when trucks, from the owner's colliery or works, reach their destination, they should then be despatched to the nearest colliery or works requiring them, or be utilized for taking goods from the point of destination to some other part, and so, by continuous oversight, and planning to make supply meet demand, utilizing to the fullest extent the carrying capacity, instead of running return trucks empty many miles during a year. In theory, this looks all right. But vast machinery would have to be set up to carry on such an organized control of traffic all over the country, and to ensure that no one quarter of the country was more favoured in the matter of distribution than another, consistent with requirement. We can see that collieries, for instance, situated near the large centres might, under Mr. Wilson's scheme, benefit greatly at the expense of collieries situated farther away, which might before the advent of the pooling arrangement have been the happy possessors of a large number of trucks, bought purposely to fully satisfy their needs, and to clothe them with greater competitive competence in view of their comparatively inferior geographical situation. The same argument applies to gas or other waggon-owning undertakings. Of course, no one can deny, when (say) gas-works owned waggons are sent back empty to a colliery for a further supply of coal, that from works to colliery there is a waste of carrying capacity; and there appears to be no reason why—if goods could be carried to towns on the line to the colliery, and providing there is not much delay—use should not to that extent be made of the waggons as a contribution in these times to the relief of what is conceded to be a very serious position. But it seems to be for private owners a very hard proposal, and one which would have for them serious effects, that the very trucks which they have provided to raise the levels of efficiency and economy, and to enable them to better meet their obligations, should be scattered all over the country without let or hindrance on their part. The pooling scheme, in short, diverts the waggons from their original object to benefit those who have not been equally, or sufficiently, prudent.

However, while Mr. Wilson asserts that, under a properly organized pooling scheme, there would be, including the railway companies' trucks, an amplitude of carrying power, he says that no doubt there would be hardships. But, if his theory is right, if he is correct in saying there would be ample trucks for all purposes and requirements, there ought not to be any hardships whatever. The fact of the matter is that the talk in favour of a pooling scheme is distinctly vague; and what those interested want to see is something more concrete in the nature of a scheme, as well as the character of the mechanism that would be brought into use to cause everything to work out with the beautiful precision that would produce an actual excess of carrying power in the country. Until scheme and operating mechanism are presented for consideration, we must lean towards the opinion that serious injustice would be done by depriving, in the hours of their greatest need, private owners of something of which they had providently become possessed.

Dr. Fleming on Electric Cooking and Water Heating.

In dealing comparatively with gas and electric cooking and heating, it is the wont of our electrical friends to talk mainly about what is called the thermal efficiency of gas-ovens and boiling-rings and their electrical equivalents. And we get various percentages mentioned by them for electric and gas types of appliances. The efficiency of the electric type may be variously stated at anything between 95 and 65 per cent., and much lower for water heating on boiling discs; while with gas anything between 45 per cent. and almost vanishing point is quoted as the percentage. "There you "are," says the electrician—who, if of anything, is a past-master of postulation—"the efficiencies of electric cookers "and water-heaters are higher than those of gas appliances." Efficiency—dealing with different heating agents, and with thermal energy supplied by them at different costs—is not the sum of the question. There are a good many other factors to be taken into account. Professor J. A. Fleming has recently, at University College, been complimenting the electric industry on the heating "efficiency" of their cooking and warming appliances, but not of much else. Of course, a high efficiency means that the margin for further

improvement is small; and if, in relation to a lower efficiency appliance, the cost of operation is about the same—perhaps greater—the prospects are that, with the good field for attaining a higher efficiency, and the equally good chance of the price of the heating commodity being reduced, the lower efficiency appliance will, on the score of running cost alone, without any other considerations—such as low initial, maintenance, and renewal costs, as well as reliability—take some shifting out, and will maintain its supremacy of adoption.

Professor Fleming, however, told his audience that for cooking purposes he considered that electricity at 1d. per unit was practically equivalent to gas at 2s. 8d. per 1000 cubic feet, which is absurd. When he speaks thus, he has to account for the difference between above 15,500 B.Th.U. and 3420 B.Th.U. procurable for a penny from respectively gas and electricity. On his statement, with gas more than 12,000 B.Th.U. are dissipated in getting accomplished the work realized by the expenditure of 3420 B.Th.U. electrically produced. And yet what do we find? That though the margin of efficiency in the case of electric appliances is so narrow for improvement, the Professor himself has to confess that the already low rates charged for current for cooking and heating are, under normal conditions sufficiently high, and they do not allow of increases ranging from 15 to 25 per cent., such as have been necessary in these war times. When these conditions as to efficiency and yet the necessity for a low price are examined attentively, the Professor's admission is found to be a very grave one—so very grave that the commercial man of the "Electrician" says: "Having regard to all the circumstances, we cannot but "agree with Dr. Fleming in his criticism." Having regard to "all" the circumstances. It is, indeed, very rarely that one gets an electrical writer to have regard to "all" the circumstances at once—he generally looks at them individually, as collectively they are apt to be overpowering.

There is another thing Professor Fleming has overlooked. His calculations regarding electric cooking and heating are apparently based on personal laboratory investigation, while it is pretty certain that several of the figures applying to gas are more or less hypothetical and apocryphal. Of course, the carefully guarded work of the laboratory cannot be transferred to the kitchen, as those central station engineers only too well know who have had experience with the electric cooking business. If Professor Fleming would only do men engaged in the practical management of the commercial business of the central station the honour of paying attention to what they have said at the meetings of the Institution of Electrical Engineers, at sectional meetings of the Institution, and at meetings of the Incorporated Municipal Electrical Association, and at meetings of the "Point-Fives" Association, he would find that it is very generally admitted that the conventional modes of the kitchen do not subscribe to refinement and to the most economical working. And a professor or a central station engineer, or other electrical expert, cannot be told off to be always supervising work in the kitchen, so as to secure the maximum economy under electrical conditions.

However, the eminent lecturer did make an admission derogatory of electrical operation. He confessed that, owing to the high specific heat of water, its electric heating was a very costly matter. And yet he pointed out that whereas the efficiency of the gas boiling-ring in heating water was only 58·6 per cent., that of an electric kettle—that is to say, a kettle with the heating element an integral part of it—is 90 per cent. But even if this high efficiency be accepted, the electric-kettle cannot do better than supply 2 pints of boiling water in a quarter of an hour, using current at the rate of ½ kilowatt per hour—or ⅛ unit for the heating of the 2 pints of water. If one calculates out the B.Th.U. absorbed in the operation of heating to boiling point the two pints of water, it will be found that Professor Fleming has taken 100 per cent. efficiency, and the full heating value of the ⅛ unit, and so has found that 2 pints of water, starting (say) at 50° Fahr., will be raised to 212° Fahr. by expending 427 B.Th.U.—almost the exact number of degrees Fahrenheit that the 2½ lbs. of water have to be raised in temperature. This has not allowed for any heat losses. If this is the manner in which other of the Professor's figures have been calculated out, then we are unable to place upon them very much reliance. Using an electric heating element separate from the kettle or other vessel to be heated, the waste is immense, and efficiency low, and, of course, the Professor has taken the best possible conditions. Even under such conditions, he finds that electrical energy would have to be supplied at $\frac{1}{50}$d. per unit to compete with coal at 20s. per ton. But he makes the remark (which is the remark of ignorance) that the heating of water plays a minor part in cooking operations. Cooking experts tell us that—including all boiling operations—about 75 per cent. of the cooking work is done on the top-plate of a gas-cooker. Of course, however eminent a professor may be, he cannot be expected to know everything about cooking; and this accounts for certain of his statements being somewhat wide of the mark, and for some of his theoretical calculations being altogether opposed to practice.

Leeds University Lectures.

The special lectures which Professor John W. Cobb, B.Sc., F.I.C., has arranged for this year in connection with the Department of Coal Gas and Fuel Industries (with Metallurgy) at the Leeds University, are set forth in the programme which appears on another page of this issue; but there are some points about the programme to which attention may be drawn here. It will be noticed, in the first place, that on the present occasion Dr. Harold G. Colman's course on "Gas Manufacture" has not been arranged for; its omission being due to the circumstances which just now must govern the engagements of both lecturers and students. As a matter of fact, in regard to those courses which are on the programme, it has been necessary to insert a proviso reserving to the University the right to cancel them, as it is recognized that the numbers of students able to attend may well be too small to justify the giving of the lectures; while there is also the possibility that such time as the lecturers still have available may be taken up by national work. Though, however, for reasons which will be apparent, conditions are adverse to comparatively long courses, Professor Cobb's experience arising out of the tar-testing work in hand convinces him that some short courses can be usefully given. He is at present engaged in testing tars from gas-works in Yorkshire and Lincolnshire for toluene and benzene, and oils in which these constituents have been absorbed from gas; and he is of opinion that a short laboratory course which would put gas-works people in a position to make tests for themselves, as often as they wished, and on as many samples as they desired, should be of service, and might have some effect in increasing the efficiency of the extraction processes. The short lecture course on coal and carbonizing is aimed at providing a summary of the fundamentals of the subject, and also at presenting what is known as to the influence of carbonizing conditions on bye-products—especially benzene and toluene. As to the work in the laboratories of the Department, it is not surprising to learn that the times are busy. Nearly all Professor Cobb's own students went at the beginning of the war; and when the tar-testing work came along, he had to draw on Professor Smithells for men, who worked at it through the long vacation, and some of them have gone on ever since. In fact, Professor Cobb refers in high terms to the zeal and efficiency of his helpers—especially his assistant lecturer, Mr. Hodsman. The ventilation research is, it may be added, being proceeded with by Mr. W. Harrison.

Gas-Fires and Electric-Radiators.

We were pleased to receive from Professor A. H. Barker, of University College, the letter which appeared in last week's issue regarding the above subject, though the pleasure need not be taken as an endorsement of all the points presented in the communication. There is regret that the comments in our previous issue were based upon a misreported passage in an electrical contemporary; but the regret is mitigated by the fact that the comment has brought from Professor Barker a very necessary correction. The effect of what he said was that the manufacturers of gas-fires had devoted so much attention to the improvement of "radiant efficiency" that the air of a room may be insufficiently warmed, although the radiant temperature may be so high as to scorch the knees of a person sitting 4 feet away from it. "There was nothing about the glowing fire-clay being too hot." This is an altogether different story from that published by the electrical contemporary which gave circulation to the statement that called for our comment. Touching the correction, it is noticed that Professor Barker regards the application of the term "efficiency" in connection with heating as being altogether out of place; and he believes that all the householder

cares about is the commercial question as to what it will cost to comfortably heat a room under given conditions. This being so, we may look at our correspondent's contention from the practical point of view. We have had a very large experience of modern gas-fires—in fact, gas-fires of many types have been in use by us for the past quarter of a century. With modern gas-fires, we have never had any difficulty in obtaining just what is required for warming a room to a comfortable temperature; and we have not noticed the scorching of our trousers, or of our hearthrugs, or of anything that is within customary proximity to the gas-fires. The gas industry has a very extensive, and not a narrow, experience of gas-fires.

Cost and Efficiency.

No doubt Professor Barker is right as to the commercial consideration applied by the user in connection with means of heating; but consideration applied by the user is not the only commercial one. Others who have to apply commercial considerations are those who come between the manufacturers and the user—such as gas undertakings in the case of gas-fires; and, in making their purchases, they must have some standard by which to adjudge the relative values of fires. They cannot before purchasing fires test them under the thousand-and-one unknown conditions under which they will be used; and therefore the gas industry has adopted the practical standard supplied by ascertaining the efficiency of fires, by means designed and approved by scientific men, and under definite conditions, by measuring radiant heat, ascertaining the amount of heat passing away by the chimney, and placing the difference to the credit of convected heat, and expressing the result in terms of the percentage of the calorific value of the gas consumed, as tested by methods prescribed by the Metropolitan Gas Referees. Professor Barker has no doubt studied all the work that has been done in this connection; and, if he has, he must admit that the science of measuring the heat-emitting capacities of gas-fires has been carried beyond any like work that has been done in any other direction. We must also for the purpose of technical discussion have standards upon which questions affecting heating values can be spoken of relatively. Under the circumstances of the means of testing gas-fires that have been made available by research, and of the fact that men of high reputation in the scientific world have put the heating capacities of modern gas-fires under proper scientific test, and have given us the results, the gas industry is enabled to make authoritative statements, and to find much that is "entertaining" in the stupid statements that are made by electrical competitors concerning their rival. The origin of these statements is enveloped in mystery, and certainly cannot be supported by the best of available scientific means of testing the thermal efficiencies of methods of heating.

Some Rating Statistics.

Those who have been in the habit of looking forward to the annual compilation of statistics with regard to rating, gas, water, and electricity charges, and municipal trading profits and losses, which for a very long time was published towards the end of each year by Mr. James Carter, the Borough Treasurer of Preston, will be glad to see from to-day's issue that though Mr. Carter is unfortunately no longer with us, the work of preparing the statistics has been continued by his successor at Preston—Mr. W. Allison Davies. The last issue edited by Mr. Carter was the thirtieth of the series; and though the particulars furnished year by year were the same, the number of towns with regard to which this information was vouchsafed, on almost every occasion showed an increase over its predecessors. By the issue of the thirtieth statement, the list of towns included had grown to 134; and this year Mr. Davies has improved on previous records by bringing the total up to 137. The additions are of towns on the small side so far as population is concerned; so that their inclusion will serve to make the figures even more thoroughly representative than has hitherto been the case.

What the Figures Show.

Glancing at the present returns and comparing the statistics (which are for 1915-16) with those of a year ago, it would seem that in the interval there has been a fairly-well developed tendency for the rates to rise; for of the towns mentioned there are 42 in which the rates amount to 9s. or more in the pound, as against only 24 in 1914-15. In two cases the amount is over 11s.—Norwich 11s. 6d., and East Ham 11s. 1d. There are a good many towns—ten, to be precise—in which, though the rates do not reach 11s., they are still over 10s. in the pound. This is a somewhat significant fact, in connection with the present call for economy in every direction. On the last occasion, there were three towns in which the rates were 5s. or less in the pound; but this time there are only two—Blackpool and Oxford. The table showing the charges made for gas for domestic lighting, bears evidence, of course, of a very general increase. A year ago, in 28 of the places included, the charge was 2s. or less per 1000 cubic feet, as compared with 31 for the year before that. Now, the number is only seven—Widnes being easily lowest, with Sheffield and Sunderland making a tie for second place. Another sign of the times is that in but nine instances have the rates of the towns referred to been relieved from remunerative undertakings to the extent of 1s. or more in the pound, a figure which compares with 17 a year ago, and 19 for the year before that. On the other hand, there were 67 cases in which deficiencies incurred in connection with such undertakings had to be met out of the rates. In most places, however, the sums were comparatively small; there being only ten figures mentioned which are over 10d. in the pound. Ten cases of deficiency occur in connection with electric light undertakings—some of them substantial.

Control of Exhibitions.

A significant intimation is being made by the Board of Trade, who call attention to provisions of the Defence of the Realm Regulations empowering the Minister of Munitions, after consultation with the Board, to prohibit, or impose restrictions on the holding of, industrial exhibitions and fairs during the war, in order to prevent the production of war material being prejudicially affected. It is to obviate so undesirable a result that the forthcoming British Industries Fair, referred to in last week's issue [which is being promoted by the Board of Trade], will be confined to exhibits of china and earthenware, glass, fancy goods, toys, games, stationery, and printing. As a further precaution, however, it is stipulated that any firm who hold contracts for a Government Department will have to obtain the permission of the Department before exhibiting. The point to be borne in mind is the statement of the Board that it is proposed to impose similar restrictions on the holders of any other industrial exhibitions and fairs. In the regulations under which this action is taken, it is ordered that any person intending to hold an exhibition or fair of the kind referred to—namely, one the exhibits whereat "consist in whole or in part of the products of any industrial or manufacturing process, or the machines, tools, and implements used for the purpose of any such process"—shall, at least one month before the date fixed for the opening, give to the Minister of Munitions notice in writing of his intention, together with such particulars as the Minister may require. Failure to comply, will constitute an offence against the regulations.

A Black List of Enemy Traders.

The Government have taken steps, by extending legislation, to do something towards stopping the trading in this country with goods of enemy origin. The gas industry has had experience of this form of trading; and we have urged that the most scrupulous care should be exercised by gas undertakings and wholesale houses to see that there is no contribution of support to the enemy by participating in such traffic. One course the Government are proposing to take is to compile a black list of traders in neutral countries, who, whether of enemy nationality or not, are substantially enemy firms who can be safely cut off from British intercourse without doing serious injury to British trade. If such a list is prepared with Government authority, we hope that it will be given the widest possible circulation, through, so far as they are concerned, the various trade papers. In the House of Commons, the hope has been expressed that the list may include firms operating not only from European neutral countries but from countries further afield. It is known that even in South America there are firms of enemy formation doing business with this country, whose money is being used to assist the enemy, and the kith and kin of the principals of which firms are fighting against this country and its Allies. All such firms should be included in the black list; and so should the agencies in this country that further the interests of the firms. However, though it is felt that the

Government are not yet doing all they might do in this matter, there is gratification that they are making another move to stop the traffic. The Board of Trade have also warned importers that goods which originated in enemy countries, although they may have left enemy territory and become neutral property before the war, are liable to seizure under the Customs (War Profits) Act, 1915, if imported without the Board's permission. In connection with this Act, the Foreign Office has a department concerned with preventing trade by British firms and companies with the enemy in neutral countries; and now it has been decided to merge into it the Trading with the Enemy Department of the Home Office, which has the duty upon it of enforcing the measures already taken to prevent trading with the enemy, and the staff of which will continue to perform the same duties as members of the new department, in addition to taking part in the administration of the new Act.

Cyanamide and Granular Nitrolim.

The proceedings at the meeting of the Nitrogen Products and Carbide Company contained a large amount of promise, but little that is at present tangible for the shareholders. It can be quite appreciated that the working has been hampered, even in Norway and Sweden, by all sorts of problems and impediments brought about by the current disturbed conditions. Of course, while the Belgian property may be intact, it cannot contribute to the activities of the Company. But about the main operations, in one part of the speech of the Chairman (Mr. A. E. Burton), we read that difficulties are being "gradually" overcome, and in another part that they have been "largely" overcome, which shows that difficulties still exist. There is no information in the report as to whether these difficulties refer to those that were raised last year as to technical and heavy capitalization troubles, and patent rights. Regarding cyanamide, the shareholders were informed that considerable quantities had been sold for chemical purposes; and that contracts for 20,000 and 12,000 tons had been entered into for this year and larger amounts could have been sold in Norway had the Company not had to reserve a given amount for their new chemical works. The rest of the output, it was said, would hardly serve to meet the rapidly increasing demands of the growing industry for the fertilizers. The information was also given that the whole of the output of granular nitrolim had been sold for the coming season, and that more could have been disposed of to a considerably larger quantity had it been available. This granular nitrolim, in addition to nitrogen, provides a supply of lime and carbon; and so it is thought that in those parts of England where the soil is poor in lime content, this fertilizer will be specially suitable—in fact, it is said that the more it is used, the greater its popularity. Among other points, information was given that large works for the production of nitric acid and nitrate of ammonia by the catalytic process are in course of erection. Altogether, it is seen that the shareholders have still to live in the future, and to hope on.

Experiences at the Parliamentary Bar.

Last Sunday's "Observer" contained an interesting interview with Mr. J. H. Balfour Browne, K.C., who, as already intimated, is retiring after forty years' practice at the Parliamentary Bar, of which he has been leader for some years past. In the main, the interview consisted of personal reminiscences regarding the "giants of former days;" and Mr. Balfour Browne concluded what he had to say in the following terms: "In these forty years I have seen a great deal of Private Bill Legislation. Great railway schemes, although possibly not such speculative adventures as those of 1845, have been passed, and millions of money have been spent in the construction of the lines. Great water-works have been sanctioned and constructed, and important sewage schemes have been carried out. Electricity as an illuminant, and also in connection with the distribution of power, has come into existence in my time; and it has now become a huge accomplished fact. Electric traction, too, has begun to drive the steam locomotive to the British Museum. Tramways have spread their metal nets not only over our towns, but over inter-town territories, and, when 'out of town,' sometimes call themselves 'light railways.' The reminiscences of forty years' practice at the Parliamentary Bar are so many that it is well to put a strict turnstile to stop the crowd. I am perhaps under the glamour as to the calibre of the leaders of my early days, and under a similar glamour as to the Committees of the seventies and eighties; but I believe that the Commons Committees in those days were better than the Committees of more recent years. They certainly worked five days a week; while Committees of the Commons to-day for the most part only sit three days, and adjourn on Thursday night until the following Tuesday morning."

GAS BILLS FOR 1916.

[First Article.]

In noticing the Bills for promotion in the next session of Parliament, there will, with the comparatively few that have been lodged, be no attempt at classification, as is customary, as between company and municipal authority, or in any other way. There are exactly a dozen Bills dealing with gas, and two Board of Trade Gas Provisional Orders. There are also four Bills in which water undertakings are concerned—eighteen measures all told, which is about a record for a minimum number so far as memory carries us back.

The first Bill to be reviewed (taking them in alphabetical order) is that of the Aberdare and Aberaman Consumers' Gas Company. By the Company's Act of 1869, the original capital was fixed at £30,000, entitled to a dividend of 10 per cent. per annum. In 1874, authority was given to the raising of additional capital to an amount not exceeding in the whole £10,000, entitled to a dividend of 7 per cent. on the ordinary shares or stock, and not exceeding 6 per cent. on the part issued as preference. The whole of the original capital has now been issued; and the powers granted by the 1874 Act have been exercised by the issue of preference shares, bearing a dividend of 5 per cent. The powers to raise on mortgage or by debenture stock extend to £10,000; and there has been borrowed on mortgage £7500. The Company now ask for powers of conversion of the ordinary capital into stock on a 5 per cent. basis, and the conversion of the preference shares into stock. They also seek authorization to purchase by agreement the property of the Hirwain Gas and Coke Company, and for the extension of the limits of supply to include the areas served by the Hirwain Company. Capital and works powers are required; and repeal is sought of section 30 of the Act of 1869 which gave the Local Board of Health (now the District Council) power to purchase the undertaking at any time after the expiration of five years from the passing of the Act, on giving six months' notice in writing. These particulars are taken from the preamble. Turning for other details to the clauses, it is seen that, starting with the capital conversion provisions, it is proposed to convert the preference shares into one class of preference stock to the amount of £10,000 bearing 5 per cent. dividend. The ordinary shares, it is suggested, shall be converted into ordinary stock to the amount of £60,000, bearing a uniform rate of dividend of 5 per cent. The additional capital sought is £36,000. Appended to the clause (which is in the ordinary terms) as to the issue of the capital by auction or tender is the following:

> Provided that the foregoing provisions of this section shall not apply during the period of five years from the date of the passing of this Act, or within such longer period as the Board of Trade may by order in writing sanction, which said sanction the Board of Trade are hereby empowered to give, and the Directors may, during such period as aforesaid or such extended period, as regards any capital required for the purposes of the undertaking during such period, create and issue such capital at such price and on such terms and conditions as they may think fit.

Provision is also made for the issue of redeemable preference stock or debenture stock, and for the creation of a redemption fund. The total of the Company's borrowing powers is proposed at £38,000; but [this follows the Ascot Act of last session in departing from the one-third proportion] "no sum shall be borrowed by the Company in excess of an amount equal to one-half of the paid-up capital of the Company for the time being." The Company suggest a standard price of 4s. 3d. per 1000 cubic feet, with the sliding-scale operating half-yearly. Clauses follow regarding the purchase of the Hirwain Company's works and for the extension of the limits of supply. The calorific value test is to be substituted for the illuminating power one; and a level standard of 475 B.Th.U. is proposed, tested by the apparatus prescribed for the time being by the Metropolitan Gas Referees. Under the clause dealing with the construction of gas-works, the new residuals provisions appear, but (properly) without the one-third purchasing restriction. There were precedents for this omission during the session of last year. Among miscellaneous clauses, it is seen that the Company desire to be exempt from supplying gas where a main is of insufficient capacity. Profit sharing and stand-by clauses also appear. In connection with public lighting, the Company wish section 46 of the Act of 1869 to be amended by the insertion of the words "for lighting purposes" after the word "consumer" in the first proviso of the section. [*Parliamentary Agents: Messrs. R. W. Cooper and Sons.*]

The Beighton and District Gas Company is a "limited" concern, which supplies gas in the parish in Derbyshire which gives to it its name, as well as in Aston-cum-Aughton in the West Riding of the county of York. The nominal capital is £20,000, of which £15,371 in shares have been subscribed. The Company now seek re-incorporation and statutory powers. It is proposed that the capital shall be £23,371, which gives £8000 as additional capital, of which not more than £5000 is to be raised as preference shares or stock. The borrowing powers are placed at one-third part of the issued and paid-up capital. The restriction is included as to raising money during the war, and for twelve months afterwards, without the consent of the Treasury. On the original capital the standard rate of dividend proposed is 10 per cent., and on the additional capital 7 per cent., or not exceeding

6 per cent. on such portion as is issued as preference. In connection with the construction of works clause, the residuals provisions appear, and rightly without the one-third restriction. The Midland and Great Central Railways have protective clauses; and so have the West Riding and Derbyshire County Councils. The area of supply is defined. The standard price of gas is put at 4s. 2d. per 1000 cubic feet, with the sliding-scale operating annually. A level calorific value standard of 500 B.Th.U. is proposed in lieu of the illuminating power one, the testing to be under the prescriptions of the Metropolitan Gas Referees. A number of clauses of ordinary character in modern gas legislation are included in the Bill. [*Parliamentary Agents: Messrs. Torr, Durnford, and Co.*]

The Colchester Gas Company have been experiencing a great increase in the demand for gas within the borough in recent years, and especially since the commencement of the war. They have extended their mains beyond the borough for meeting the demands for gas; and these mains have been further extended for the purpose of satisfying military requirements. In view of these increases and the potentialities, the Company desire to construct new gas-works, and to have their limits of supply extended. Under the Company's Act of 1866, their capital was: Original, £20,000; additional, £20,000. Loan: Original, £5000; additional, £5000. Under the 1875 Act, £10,000 additional was authorized, and £2500 of loan capital. The whole of the authorized share and loan capital has been raised; and the Company have in addition, received an amount of £4815 by way of premiums. Beyond the authorized share and loan capital (including the premiums), they have expended on purposes to which capital is properly applicable, a sum of £2600, which now stands to the debit of the capital account. They require to be empowered to extinguish this debit. Lands are scheduled on which the Company desire to construct further works; and following the works clause is the new residuals provision, without, as in the preceding cases, the one-third restriction. Power is desired to erect two bridges or overhead constructions over Hythe Quay Road for the conveyance of coal and other commodities from and into the gas-works, with authority to operate the overhead constructions by electric, steam, hydraulic, or any other form of mechanical or animal power. If these overhead constructions are not completed within the period of five years from the date when the Treasury shall give their consent to the raising of the money requisite for the erection, or within a period of six years from the termination of the present war (whichever is the earlier period), then, on the expiration of the earlier of such periods, the powers are to cease, except as to so much as is completed. Power is required to stop up a footpath, and construct a new one. Extension of the limits of supply is sought, together with confirmation of the laying preceding authorization of mains in the extended area. The Company propose a calorific standard in place of the illuminating power one. They suggest adopting a "calorimeter to be agreed upon between the Company and the Corporation, or, failing agreement, to be approved by the Board of Trade, which shall be so constructed as to be capable of yielding the total heat value expressed in British thermal units, of the gas supplied by the Company." The standard is the marginless one of 500 B.Th.U. The requirement as to additional capital is £90,000. The prescribed scale of voting in respect of any stock in the additional capital authorized by the Act is proposed as follows:

> Every holder of such stock shall have one vote for every £20 of stock up to £200; and he shall have an additional vote for every £100 of stock beyond the first £200 thereof held by him up to £2000 of stock, and an additional vote for every £200 of stock beyond the first £2000.

The dividends are to be on any preference capital issued as additional capital under the Act, such rate (not exceeding 7 per cent. per annum) as shall be specified in the resolution creating such stock; on the original capital, 10 per cent. per annum; on the additional capital, under the Acts of 1866 and 1875, and on any ordinary capital issued under this Act, 7 per cent. per annum. On mortgage the Company may borrow in respect of the fully paid-up capital of £50,000 created or issued under the Acts of 1866 and 1875 and of the premiums received, any further sum not exceeding £5500, and in respect of the additional capital authorized by the present Bill one-third part. Power is to be taken to issue redeemable preference capital or debenture stock, and for the formation of a redemption fund. The Treasury clause appears as to raising money during the war and for twelve months after. Regarding the extinguishing of the capital debit balance, the following clause is proposed:

> The Company may, at any time prior to the 1st day of January, 1917, transfer to capital account such sum or sums as they think fit out of the amount standing on the 31st day of December, 1915, to the credit of the profit and loss account which was carried forward to the next account, and any sum or sums so transferred shall be applied firstly in extinguishing the amount of the debit balance on capital account at the passing of this Act, and then to any other purposes of the undertaking to which capital is properly applicable.

The standard price for gas is put at 3s. 9d.; with the sliding-scale operating half-yearly. The charge for gas to consumers in the extended area, it is proposed, shall not exceed the price in the borough by more than 9d. Provision is made for differential prices according to the purpose for which gas is used, "provided that the Company shall not, under the powers of this section, give any preferential price as between any consumers who shall take a supply of gas for the same purpose under like circumstances." Pension and profit-sharing clauses are included; and amendment is desired to the "Price of Gas for Public Lamps" clause of the Act of 1875 by the insertion of the words "for gas supplied for lighting purposes only" after the words "charged from time to time." The prepayment clause provides for the usual 10d. for meter and fittings, and 1s. if including cooker; but it is added, "or in either of such cases at the rate of 10 per cent. per annum on the cost of the meter and fittings, whichever shall be the higher." Most of the other clauses are now common to all Gas Acts. [*Parliamentary Agents: Messrs. Rees and Freres.*]

The Ferndale Gas Company is a "limited" one; but it is now proposed to clothe it with full statutory powers. By the Company's Order of 1883, it was provided that the capital should consist of the original share capital of £10,000 and of additional capital not exceeding £10,000, with borrowing powers amounting in their entirety to £5000. The whole of these sums have been issued; and premiums have been received in respect thereof amounting to £1259. The dividend on the original capital is 10 per cent., and on the additional capital 7 per cent., subject to the operation of the sliding-scale. The Company have raised £5000 by the issue of debentures, in conformity with the 1883 Order; and they have also borrowed sums amounting in the whole to £11,400 otherwise than on mortgage of their undertaking. A structural valuation of the works, &c., amounts to £33,860. The expenditure on the undertaking totals £37,660; and it is now considered expedient that the unproductive capital —amounting to £3800—should be redeemed and cancelled. In the additional capital to be authorized, the Company desire to include the money requisite to pay off the loans of £11,400. Another matter which the promoters wish to be dealt with is that, under the powers of the Order of 1883, they acquired certain leasehold lands, and have erected thereon a gasholder and other works, which have been used for the storage of gas since 1896; and they now submit that it is expedient to empower the Company to store gas on the lands, and certain adjoining lands proposed to be used for this purpose. The foregoing facts are taken from the preamble. From the clauses, it is seen that the proposal in respect of additional capital is £25,750, provided that the share capital under the 1883 Order and this Act shall not exceed £45,750. The dividend on the additional capital is proposed at 7 per cent. on the ordinary, and not exceeding 6 per cent. on the preference. It is asked that section 25 of the 1883 Order [Fixing Maximum Price of Gas, with Sliding-Scale as to Dividend], in its application to so much of the additional capital as is issued as ordinary, shall be read and have effect as though 3s. 6d. had been inserted therein instead of 5s. Borrowing powers are desired on the customary one-third line. A capital redemption fund is asked for. In any year in which the divisible profits exceed the amount required to pay the dividends on the preference capital, a dividend at the rate of 5 per cent. per annum on the original share capital, and a proportionate dividend on the additional share capital (whether issued under the Order of 1883, or under the provisions of this Act), the Company "shall transfer to a fund to be called the 'capital redemption fund' the balance of such divisible profits remaining after paying the said dividends, provided that, as soon as the Company have transferred to the fund sums amounting in the aggregate to £1900 this subsection shall cease to operate and have effect." The Directors may, in addition, if they think fit at any time appropriate out of revenue as part of the expenditure on revenue account, and transfer to the fund, any sums not exceeding in the aggregate £1900. Every sum so transferred is to be applied to the purchase of ordinary or preference shares or stock, which is to be cancelled and extinguished. Except in the open market, the Company are not to purchase any shares or stock at a price exceeding that at which, according to the records of the Company, the last transaction in shares or stock of the same class took place. The Treasury capital restriction clause, it is proposed, shall be extended as follows:

> Notwithstanding anything in this Act, the Company shall not under the powers of this Act raise or borrow any money, except (*a*) for the payment of the costs, charges, and expenses referred to in the section of this Act of which the marginal note is "Costs of Act;" (*b*) for the discharge of the recited loans amounting to £11,400; and (*c*) a sum of £8000 for the payment of an additional gasholder now in course of construction, during the continuance of the present war and twelve months thereafter, unless the consent of the Treasury has been previously obtained.

The illuminating standard and test are to be abandoned in favour of a level 500 B.Th.U. standard, with test under the prescriptions of the Metropolitan Gas Referees. Differential prices, with a guard against preferential prices, are provided for. As in most of the other Bills, protection clauses appear as to the supply of gas where there is an alternative supply of gas and electricity, and where mains are of insufficient capacity without jeopardizing private supply. [*Parliamentary Agents: Messrs. Lees and Co.*]

Dr. Frederick S. Pearson, of Great Barrington, Mass., who was at the head of the group of capitalists controlling, among other undertakings, the Brazil Traction, Light, and Power Company, the Barcelona Traction, Light, and Power Company, the Rio Janeiro Tramway, Light, and Power Company, and the Mexican Light and Power Company, left estate in the United Kingdom of the gross value of £328,860.

ELECTRICITY SUPPLY MEMORANDA.

A REVIEW OF THE PAST YEAR.

THE general experiences of the electricity-supply industry during the past year have been very much the same as those of the gas industry, with perhaps greater divergencies between different electric undertakings owing to the wide dissimilarity in circumstances. The same influences that have affected gas undertakings have borne upon electricity concerns. Coal has been the *bête noire;* street and shop lighting restrictions have curtailed business; and the undertakings have not escaped household economy. But in those favoured districts near to the coal-fields, and where there has been a flood of munitions work, and electric power has been in large demand, there affairs have had a more gladdening aspect than in those localities where the electricity concerns have had to pay heavier costs for fuel delivered, and where perhaps their main source of income has been residential. These latter must have been very hard hit. However, the electricity supply industry has not had to deal with residual products under war conditions; it has not had to help the country to obtain from within itself many substances that are urgently required in the war; and it has not had to help forward the dye scheme by producing raw materials necessary to its existence. Nevertheless, within the limits of its activities, it has, speaking generally, been badly affected.

UNDER WAR CONDITIONS.

In connection with coal, the electricity industry—at any rate, in some quarters—does not appear to have properly gauged what should be its position to meet times of great emergency. Early in the year many undertakings were suffering from shortage of coal—for the same reasons as were described in our Gas Retrospect of last week; and they were faced, too, with much heavier expenses for their next contracts. Under the circumstances (though the electricity supply industry was not so deeply involved in the coal trouble as was the gas industry, owing to the quantitative difference in requirement), the gas industry had a conference with its representatives, and mapped-out a movement for seeking relief from the then present, and greater menacing, conditions, which movement has borne good fruit. But notwithstanding the experience of last winter and the spring, notwithstanding, too, the warning given some months ago as to the prospects of this winter, notwithstanding the opportunity there was during the summer and autumn months for stocking coal, of which there was then an abundant supply, before Christmas there was an outcry as to deficiency of deliveries and vanishing stocks. The fuel bill is this year going to be a heavy one for all electrical undertakings; and many of them with contracts for power at prices calculated out (under normal conditions) with such mathematical accuracy that the profit said to exist on the charge per unit is not visible to the naked eye, will stand to lose on them, unless subject to a coal clause. In consequence of the coal position, quite a good number of central stations have taken to using coke or coke breeze; and so necessity has compelled an experience which it was difficult to secure under ordinary circumstances, and with custom resolutely governing. Engineers have found that, with mechanical stoking arrangements and forced draught, most excellent results are attainable—results exemplified by Mr. E. W. L. Nicol (the technical expert of the London Coke Sales Committee) when he said that 1 lb. of average gas coke is capable of evaporating 10 lbs. of water from and at 212° Fahr.

Then there have been the restrictions as to capital-raising for extensions and expansion of business. The Local Government Board have proved themselves excellent watchdogs for the Treasury in this matter; and unless the managements of concerns have been able to prove that the necessity for expenditure arises in connection with munitions work, they have been met with a blank refusal, or have only been allowed sufficient money for meeting some actually pressing requirement. But it was wonderful what a number of managements discovered, after the capital restrictions were imposed, that extensions of their plant were urgently needed; and it is equally extraordinary what a considerable proportion of the undertakings have found that, under compulsion, they are getting along quite nicely without the expenditure. The Treasury and the Local Government Board have been acting wisely in this matter; for present dear capital, dear materials (especially copper), and dear labour would not assist the future economic position of electric supply concerns. But what has grieved many a short-sighted electrical writer on the subject has been that the restriction has been a hindrance to business development. After the war, the administrators of electricity undertakings will be better able to take measure of their position and prospects than they are now. That the financial position of many central stations under current circumstances is something of grave concern to the managements is confessed by the resistance offered to the making of concessions in respect of the lessened street lighting and the lamps supplied under contract for shop lighting. Advances in prices to electricity consumers have been pretty general throughout the country; but there have been protests in certain electrical papers against the full burden of the extra costs due to the war falling on consumers. Whence those who have made protest think that in the case of municipal concerns the money should come, we do not know. But there are some concerns that will, through not putting all the burden on the consumers, have to unfairly have recourse more heavily than ever to the rates, and the number of concerns that will require assistance will be larger than in normal times—simply because of the fear that by putting up prices to an amount that will produce a clean balance-sheet, consumers will be induced to transfer their custom. This is an acknowledgment of the part that price has in the maintenance of electrical custom. With regard to supply companies, they are putting, practically speaking, all the additional cost on the consumers, and (unlike the sliding-scale gas companies) are not allowing their dividends to be affected, or anyway but slightly.

TRADING.

We must admit that there has been during the year a lessened display of that particular form of electrical lunacy that has in the past regarded as dispensable the gas industry and all its products. The war has done something to force into the vacuity that former evidence showed existed in not a few electrical skulls some ideas as to the large place that the gas industry occupies in the affairs of the world, in addition to supplying light, heat, and power. But though there has been this diminished display of foolishness and indiscretion, there are indications that the electricity supply industry intend to keenly persevere with business development immediately it is released from its present limitations at the close of the war. The Incorporated Municipal Electrical Association have at work a Sales Development Committee, which is divided into Sub-Committees for special purposes. The Committee are at work; but nothing great in the nature of the result has yet been disclosed. The old Electricity Publicity Committee is still breathing, but is more than ever incapable of energy and good work. There was a suggestion made that there should be a fusion of the Committee and of the Sales Development Committee; but the older body is against ending its useless life by the process of absorption. A point that has been raised more than once in the course of the year has been the trading antagonism between municipal gas and electricity committees. There has been quite a considerable amount of trouble over the matter; but Mr. J. G. Newbigging ventured to suggest a way that might, or might not, produce lasting peace. It was a feature of his British Association paper; and it was to the effect that, where gas and electricity concerns were municipal possessions, the whole of the lighting should in time to come be taken over by the electricity undertakings, and the gas undertakings be left in charge of the heating field. Neither the one industry nor the other would ever agree to any line of demarcation being placed upon its operations; but the idea coming from the Chief Gas Engineer of the Manchester Corporation, gave our electrical friends an opportunity of doing a little screeching over the supposed admission of a weakening of the gas industry on the side of lighting, and of a growing superiority of the electricity industry, which, of course, taking all things into account, no one in the gas industry subscribes to—excepting perhaps one or two men.

IN THE LIGHTING FIELD.

By those who make close observation, it is acknowledged that there is little chance in the lighting, heating, and power fields of electricity making much, if any, further progress in efficiency. Take incandescent lamps for example. The finding of materials for filaments that will stand higher temperatures seems to defy all research; and, even if such materials could be found, the intrinsic brilliancy of present filaments has reached a point that is inflicting considerable harm upon the eyesight. With regard to electric heaters, there are some that have had attributed to them an efficiency of 80 per cent.; and it is claimed that motors of moderate power, speed, and voltage are on the market with an efficiency of 85 per cent. So that, looking at these claims, there is not much chance of further increasing the efficiency of electric appliances.

In connection with the so-called "half-watt" lamp, the fraudulent character of the name has been conceded by some manufacturers and several conscientious electricians; and it is now called by them the "nitrogen-filled" lamp. There has also been a movement to rate lamps on their wattage, owing to the unreliability of the candle power of lamps, even when drawn from the same batch; but the absurdity of a wattage rating alone as a description is evident from the different efficiency of different lamps. With some lamps 1-candle power is obtained from (say) 1·7 watts, and in another lamp from (say) 0·75 watt. If all possessed the same efficiency, there would not be so strong an objection. But the consumer requires to know for guidance what he may expect in the way of candle power for the consumption ascribed to any given lamp. It is also admitted that, in the case of metallic filament lamps, the light emission is less in all other directions than the horizontal, and that the mean spherical candle power is about 20 per cent. less than the horizontal (or nominal) candle power. However, to return to the "half-watt" lamp, there has been a large displacement by these of electric arc lamps in the streets, on account, first, of the shortage in the supply of carbons due to the war, and, secondly, because of the reduction of labour in cleaning and trimming. But it is confessed that, owing to the high temperature at which the new lamps are run, there is considerable trouble with the fittings. Of course, some electrical writers assert that there is not any trouble; the more truthful state otherwise. With mixed feelings, electrical engineers received the intelligence

that lower "half-watt" units were available—that for pressures of 200 to 250 volts, lamps were on the market of 200-candle power; for pressures of 100 to 120 volts, lamps of 120-candle power; and for a pressure of 25 volts, lamps taking only 15 watts per hour. The prices of these new lamps were quoted in the "Memoranda" for July 13. It is stated that, by using argon instead of nitrogen for filling the bulbs, smaller units suitable for domestic use will soon be on sale; but central station engineers do not generally look with magnanimous feelings upon lamps that will reduce their domestic lighting load—the price received for the lighting units being the backbone of their revenue. Another high-efficiency lamp has been produced by the Edison-Swan Company. In respect of shape, size, bulb, stem, and cap, its characteristics are those of an ordinary incandescent lamp; but it has an arc as the source of light. Its efficiency is stated to be 2 candles per watt; but it has an intrinsic brilliancy of no less than 10,000 candles per square inch, as against 1000 candles per square inch with the metallic filament lamp, and 375 candles per square inch with the carbon filament lamp. Dealing with the subject of the ideal light, Dr. Herbert E. Ives stated during the year that the vacuum type of tungsten lamp is three hundred times as bright as the brightest object by day—viz., a white surface in the sun; while the nitrogen-filled tungsten lamp is a thousand times as bright. It is obvious from this that these lamps are not "ideal" as lighting agents; and the new production of the Edison-Swan Company is far from being so, though it will without doubt have scope in application to special purposes. However, with all high intrinsic brilliancy lamps, there must be protection for the eyes. In this connection, Mr. L. Crouch stated in a series of articles published in the course of the year that, used with indirect lighting fittings, the efficiency of the "half-watt" lamp is not higher than 1 candle per 1·6 to 1·7 watts.

It is interesting to note that at Woolwich Arsenal, additional high-pressure gas-lamps have displaced arc lamps—thus releasing energy for machine-tools; that at Belfast gas has displanted electric lighting in the streets, so as to relieve the central station; and that on the tramway route at Preston, gas has, after comparative trial, been chosen in preference to electric-lamps.

There has been a revival of talk and experiment in respect of the lighting by electricity of workmen's dwellings at fixed prices. But time after time it is found the project does not get beyond, or very little beyond, the experimental stage, although figures are published to show the "profitable" nature of the venture. But, as a rule, the figures refuse to stand any analytical test. The Fixed Price Light Company do not make any disclosure as to whether or not they are making a success of their enterprise; but at Wimbledon proposals have been made for putting an end to the agreement between Council and Company.

During the year, the report of the Committee on the Lighting of Factories and Workshops was issued; but it did not altogether please one electrical writer, because it was not sufficiently anti-gas or sufficiently pro-electricity. One point of interest was that ophthalmic surgeons supplied evidence that workers frequently complained of harm to their eyes where electric light was used. And yet tests at the National Physical Laboratory with workers showed that there would be considerable uneconomy if indirect or semi-indirect systems were adopted in factories, owing to the larger amount of current that would have to be consumed in order to give the workers sufficient light.

Electric Cooking.

With regard to electric cooking, progress is slow, due to a combination of retarding factors which cannot be dismissed. There is the high initial cost, and the expense of maintenance. Unreliability, too, is complained of, even by electrical engineers. We had example of this in a paper read by Mr. W. R. Cooper before the Institution of Electrical Engineers; as well as in a discussion by the "Point-Fives." Voltage variations and surges have also a bad effect upon uniformity of operation. Besides electricians have cause to complain bitterly of the waste of electrical energy by servants. It is in the hot-plates where most waste occurs, and where breakdowns are the most frequent. Owing to the costs, and the reluctance of householders to spend money on electric cooking apparatus, a new tariff has been adopted at Marylebone—a lump sum, and, instead of ½d. per unit beyond, ¾d. per unit; the additional ¼d. being to cover the hire of apparatus. From published information, it is seen that electricians do not credit electric appliances with long life—15 to 50 per cent. on cost being the range of hiring rates for different towns and different appliances. Among new ideas—this emanating from America—is the thermostatic control of the temperatures of electric-ovens; but the difficulty is that in cooking many different temperatures are needed. Not much has been heard during the year respecting water-heating. Mr. A. H. Seabrook still persists in his postulation that water-heating can be done electrically as cheaply as by gas; but he does not appear to be prepared to take part in a conclusive demonstration to prove the assertion. Of course, he knows full well that in such a comparison electricity would show up very badly—in more ways than the one of cost. Most electrical engineers recommend water heating by coke where electric cooking is adopted.

Heating.

In electric heating, the so-called "radiators," with Teutonic sausage-shaped heating lamps, appear to be going to the scrap-heap. The gas industry has mercilessly sent many there. The electric successors are fires of the bar type—the bars being composed in most cases of fire-clay, with the wires run on the corrugated surface. Each bar has a loading of 800 to 1000 watts; and a fire may be made with up to five bars, which can be used individually or collectively at will. When the weather is cold, a fire running away with four or five units per hour will be an expensive form of heating. Several times during the year, some curious comparative figures have been put forward by electricians, to show that electric heating is no more costly than gas heating; but these are always worked out—completely ignoring scientific tests—on the assumption that the gas-fire has only an efficiency of 20 to 25 per cent. of the heat generated by the combustion of the gas. But the electricians who make these silly statements (there were some in the past year) cannot substantiate them; and it is clear that they go on guesswork, and not on the results of tests made scientifically and by men of reputation—such tests as those with which we have confronted them. Among other things that have invited attention during the year in connection with heating is the proposal that chimneys should be abandoned in bedrooms, and thus insanitary conditions be promoted in order to compel the adoption of electric "fires." Of course, electric fans could be installed. But these mean additional cost, and are prone to failure just when most required. And who could stand the incessant buzz of an electric-fan in the bedroom? In a pamphlet, Mr. George Wilkinson, of Harrogate, confessed that in an electrically operated house, the electric fires had to be supplemented by other means of heating in the winter. This is what one knows must happen if there is to be comfort.

Power.

There is little to say about the power branch of the business. The gas-engine prospers; and the electric-motor also receives considerable adoption. The steam-engine is suffering most from competition. It is agreed that for certain purposes, and in certain places, the electric-motor has conveniences; but in regard to costs, Mr. Tookey (as indicated last week) has shown the gas-engine to be the cheaper working medium for the manufacturer. A series of articles in our columns by Mr. H. C. Widlake has also shown the advantage of the gas-engine in respect of more than the monetary one. These articles also presented the fact that there is cheap provision of electricity through the gas-driven generating plant. During the year, the Southport Corporation Gas Committee stated that they had refused an offer of the Electricity Committee to supply energy at 1½d. per unit, seeing that they could generate it for themselves at a cost of less than ½d. In this connection, it will be noticed that Parliamentary Committees are not averse to allowing the hiring clause in gas companies' Bills to include dynamos with gas-engines, as witness the Spennymoor Bill. In connection with the supply of energy to motor-generators, some discussion has been raised as to whether this should be charged for at lighting rates or power rates. In the Alloa Sheriff's Court, it was held that it was a power charge. The stand of the electricity suppliers was made upon the fact that the electricity on the other side of the motor generator was used for lighting purposes. All electricians do not endorse this absurd contention. Mr. A. J. Abraham, of Aberdare, is one who does not. He stated, in a communication to an electrical paper, that he had entered into a contract with the Gas Company for the supply of electric energy; but he had not said: "I cannot supply you at power rates because you are using current for making gas for lighting purposes." There were complaints during the year that motor-generators, besides being uneconomical, are noisy.

Generating Plant.

There have been several attempts at deriving consolation from the fact that, with the coming of dear fuel, electricity production has been considerably reduced in cost by the steam-turbine. Mr. C. P. Sparks, President of the Institution of Electrical Engineers, in his address, particularly called attention to this; and he stated that the development of the steam-turbine, and the adoption of superheated steam, and suitable condensing facilities, had entirely changed the character of supply undertakings by increasing the size of the operating units. But, of course, only the more favoured stations can utilize the steam-turbine; and we come down to sizes where it is not economical compared with certain other forms of prime mover. As a matter of fact, even with the turbine, there is great heat inefficiency. Of the full energy of the coal, only about 70 per cent. reaches the inlet-valve of the turbine in the form of steam. About 80 per cent. of this energy is lost in converting it to mechanical power; so that there is only about 14 per cent. of the energy of the coal available at the turbine shaft. Only 10 per cent. reaches the lamp terminals; and of this only a small percentage is converted into light. The Accrington electricity supply station remains the sole producer-gas driven station in the country. But Mr. Sparks thinks that the next general step in advance will be boiler-firing by producer-gas, with recovery of bye-products. The Yorkshire Power Company are firing the boilers at one of their stations with coke-oven gas; and from Glasgow experiments have been announced in the firing of boilers with producer gas. Early in the year we published a description of the Wood Green gas-driven generating station of the Tottenham District Light, Heat, and Power Company. The users of Diesel oil-engines for generating electricity have had to bemoan the price of oil, and their choice of a prime mover.

Legislation and Legal.

The legislative work of the electricity industry was considerably attenuated by the withdrawal, at the request of the Government, of the highly contentious London County Council Bill for co-ordinating the electricity supply of London and a large environing area, and of the Bill promoted jointly by ten London Electricity Supply Companies. The Yorkshire Power Company lost their Bill, which was intended to give them unusual powers in respect of electric lighting without bringing them under the ordinary electrical legislative obligations. The Northumberland clause was inserted in the Southampton Bill, at the instance of the Gas Company, in respect of an extension of the electricity supply area. Several municipal Bills contained hiring and wiring clauses, of a character which aroused much opposition from electrical contractors, and led variously to defeat locally or else in the Parliamentary Committee rooms, or to agreement for the adoption of the model clauses. In connection with their ancient Bill, the Incorporated Municipal Electrical Association tried to arrive at a compromise with the Electrical Contractors' Association, but failed. The promoters are now proposing to introduce into the Bill a clause to sanction modes of charging different from the usual statutory method. This evidently has something to do with the Long Eaton, Ilford, and South London decisions as to preferential charges. The Ilford case was one that caused some amount of consternation in the industry during the year, for it referred not only to charges, but to the hiring-out of appliances, &c., without specific statutory authority. The Pope Lamp Company have up to the Court of Appeal defeated Osram Works, Limited, in respect of their action for infringement.

Failures, Fires, and Fatalities.

The year has been marked by quite a number of failures of supply, fires, and fatalities. We have not a complete record, but only examples—the electricity industry (we have heard of definite cases) having the knack of suppressing a goodly proportion of the mishaps. The "Lancet" during the year called attention to the cutting-off of the electric current, during an air raid on the East-Coast, while an operation was in progress at a nursing home. In January, there was a collapse of the supply at New Malden; on Feb. 6, at Ammanford; on Feb. 8, in a large part of Sheffield; in June, at Maidenhead; on Sept. 25, at Todmorden; on Oct. 12, at Birmingham; on Nov. 17, at Wolverhampton; on Nov. 30, at Wednesbury; just recently, and more than once, at Wigan; on Dec. 5, at Finchley; on Dec. 9, at Luton; and also in December, at the Congregational Church, Victoria Road, Newport, during a service, on which occasion the organ also broke down.

Several accidents at electricity stations with uncomfortable effects on the supply, as well as several triumphs in the way of fire-raising, have occurred during the year. At the Ebbw Vale Iron and Coal Company's works, there was a disastrous fire; at Cardiff considerable damage was caused by the bursting of a fly-wheel; there was a big fire at the Belfast electricity station; and an explosion was highly disastrous at the Dublin station. Earlier in the year, the Ipswich power station suffered from fire. On Feb. 9, there was a fire at the Newport Town Hall, which was attributed to an electrical mishap; on April 6, on the premises of the Young Men's Christian Association at Newcastle, through a reported defect in an electric motor which worked a fan to clear the air from a café in the basement; early in September, at the Mosalline works at Greenwich, there was a fire due to an electrical cause; in September, at a Bradford Picture Theatre; and on Oct. 29, in Old Change, St. Paul's Churchyard. An instructive comparative table, by the London County Council, as to lighting agents and fires, was published in the columns of the "Journal" for Aug. 24, p. 392.

In his last published annual report, Mr. G. Scott Ram, the Chief Inspector of Factories and Workshops, called attention to the number of dangerous electric installations still found in factories and workshops. He also enumerated a large number of electrical accidents, including twenty fatalities, some of which were at voltages ranging between 140 and 250. There were several fatalities caused by electricity in factories, mines, and elsewhere during 1915. Some have been noticed by us; but only by way of example, and not by any means as a complete record of these occurrences.

Shell Treating by Gas.—In the course of an article accompanying a photograph of a set of shell-treating furnaces in use in one of Toronto's munition factories, Mr. H. E. G. Watson (of the Industrial Fuel Department of the Toronto Consumers' Gas Company) draws attention to the many uses of gas-furnaces in turning out munitions of war, and points out that not only have standard gas-furnaces been employed in this connection, but the war has so stimulated men's minds that hundreds of gas-fired furnaces are now being used 24 hours a day which a year ago were not even designed. He says there is nothing of this kind that requires more careful handling and more exact temperature than the heat treatment of shrapnel shells. If every little part is not "just so," not only is the shell harmless to the enemy, but it is actually very apt to injure our own men. During its manufacture, the shell passes through no less than five different heat treatments, each one of which must be a definite temperature,

PERSONAL.

Mr. M. Spittle, the Manager of the Thurles Gas-Works, has been promoted to the managership of the Dungarvan Gas-Works, owned by the same Company.

Following upon the inquiry that has taken place into the working of the Mansfield gas undertaking [to which reference was made in the "Journal" for Nov. 9 last, p. 330], the connection of Mr. W. J. Rendell Baker with the Corporation is being severed, as will be seen from an advertisement appearing in our pages to-day for a successor to him as Gas and Water Engineer.

It is a pleasure to record that Second Lieutenant Gordon Helps (the only son of Mr. W. D. Helps, of Leeds) is included in Sir John French's recommendations for gallant and distinguished conduct in the field. Lieutenant Helps volunteered on the day war was declared, and was gazetted on Aug. 22, 1914, to the 3rd W.R. Brigade Royal Field Artillery (T). He has been in Flanders for many months.

Mr. William Belton, who has been Engineer, Secretary, and Manager of the Shrewsbury Gaslight Company for upwards of thirty-six years, has relinquished the post of Manager, but retains those of Engineer and Secretary. Mr. C. M. D. Belton, who has been with the Company for six years as Assistant Engineer and Secretary, is now also appointed Manager. These changes date from the 1st inst. Mr. C. M. D. Belton (a son of Mr. J. C. Belton, the Engineer and Manager of the Chester Gas-Works), during his service with the Shrewsbury Gas Company, has duly qualified by examination and has been admitted an Associate Member of the Institution of Civil Engineers, an Associate Member of the Institution of Mechanical Engineers, and an Associate of the Chartered Institute of Secretaries.

OBITUARY.

On Monday of last week, Mr. Samuel B. Clapham, of Keighley, who was 66 years of age, died after a brief illness. He was a son of the late Mr. Thomas Clapham, one of the founders of Messrs. Clapham Bros., Limited, of which firm deceased had been Chairman of Directors for some years.

The death has occurred, at Cassel, Hessen, Germany, of Dr. Heinrich Debus, F.R.S., who for many years was a lecturer on chemistry in this country. He was at one time (among other appointments) Professor of Chemistry at the Royal Naval College, Greenwich, in which position he was succeeded, in 1888, by the late Professor Vivian B. Lewes. He was also three times (on each occasion for a period of five years) appointed Examiner in Chemistry to the University of London. At the time of his death, deceased was in his 92nd year.

At Leamington, last Wednesday, the death occurred of Mr. E. Orford Smith, who was for over a quarter-of-a-century Town Clerk of Birmingham, from which position he retired, owing to ill-health, in 1907. Deceased, who was 74 years of age, was long regarded as an authority on municipal law. Among his many activities, it may be mentioned that he was a member of the Royal Commission on the Government of London, and also of the Royal Commission on Local Taxation. In 1865 he entered into partnership with the late Mr. Bolton, of Solihull; and while in business there, he promoted the Solihull Gas Company. In connection with the Welsh water scheme of the Birmingham Corporation he, of course, took an important part in the whole of the parliamentary proceedings.

NITRATE OF SODA POSITION.

Of late, through the newspaper Press and otherwise, both sulphate of ammonia and nitrate of soda have been to some extent before the public. On the one hand, there have been arguments as to the advisability or otherwise of allowing sulphate of ammonia to leave our shores; and, on the other, we have lately had an admission of the difficulty of getting nitrate in—that nitrate which it had been arranged should be brought from Chili to this country could not at present be imported, owing to the impossibility of securing the requisite freight.

This latter is a difficulty in connection with the nitrate of soda market which is emphasized by Messrs. W. Montgomery and Co. in their report dealing with the trade during the past half year. Sailing ships, they say, which before the war were obtainable at 20s. per ton, are unobtainable to-day for prompt loading at 80s., while steamers are sought for, but not found, at 120s. Only for March and April loading, and onward, might anything be obtainable at near these prices. Assuming that the demand for freight has been much greater than the supply, they look for higher, and not for lower, freights until this order of things is reversed—"which to-day seems to be not very near." These being the conditions, it is hardly surprising to learn that, while at June 30 due or arrived cargoes of ordinary quality were valued at about 10s. 9d. per cwt. cost and freight, it is doubtful if to-day one could be obtained at even 13s. 9d. for arrival at any time between now and next March. The demand of this country, of our Allies, and of America for nitrate of refined quality for explosive purposes has been growing apace; and under these circumstances it cannot

be wondered at that prices continued to advance. Then followed the natural result. As prices advanced, oficinas which had been closed-down because of the unremunerative prices prevailing in the earlier days of the war, resumed operations; and this led to a considerably increased production, and then to a check to the high prices obtaining for nitrate f.o.b. in Chili. It is, Messrs. Montgomery think, somewhat questionable whether the check and consequent fall in prices was not brought about by the closing of the Panama Canal to traffic and the difficulty of obtaining freight; but, as they remark, it is quite certain that nitrate in Chili is of no use to European or American consumers, whatever the price, if it cannot be conveyed to their door.

Referring to the matter mentioned in the opening paragraph of this article, the report points out that some weeks ago importers were deterred from making provision as usual for their season's requirements by rumours of a large quantity of nitrate which might come on the market at much lower prices than those at which they could combine nitrate and freight. Only within the last few days has it become known that this nitrate is not likely to be shipped, owing to the impossibility of obtaining freights; and thus it is they fear that the supply will be sufficiently slender to bring about further advances. It is, however, the report proceeds, "well to know that the farmer is, generally speaking, well able to afford any advance which is likely to take place, and will make use of all the nitrate he can obtain, in order to bring the largest possible amount of cereals or root crops to the remunerative markets now obtaining."

With regard to prices, it is remarked that during the past six months these have advanced without a break so far as nitrate in stock in Europe and afloat was concerned; but the f.o.b. price in Chili reached high-water mark about mid-October, when 9s. 9d. per quintal for refined and 9s. 7d. for ordinary quality were reached, up to January shipment. About that time considerable business also took place in Chili at 9s. 1d. per quintal for January-June shipment, and 8s. 3d. July-December, 1916, for ordinary quality; while the figures for refined were 9s. 5d. and 8s. 8d. per quintal respectively. Business also took place for as far forward as the whole of 1917, in ordinary quality at 7s. 9d. and in refined at about 8s. 1d. per quintal. From mid-October onward, however, prices declined; and to-day, we learn, quotations are rather nominal, for lack of tonnage, so far as the next six months are concerned. A feeling of depression from this cause and the shadow of increasing production has come over the f.o.b. market; and Messrs. Montgomery think that possibly they would not be far wrong in saying that there is but little difference in prices for any positions from now to the end of 1917—taking these at about 7s. per quintal for ordinary, and 7s. 4½d. to 7s. 6d. for refined. At the same time, they add, it is tolerably certain that, until a more plentiful supply comes forward, prices on this side can only advance; and it is doubtful if any easing-off can take place before Midsummer, if it does then.

Though it is found hardly practicable to give figures, owing to the difficulty of obtaining accurate stock returns, the opinion is expressed that consumption in the United Kingdom has probably been maintained during the past six months so far as agricultural quality is concerned, but that the consumption of refined quality has trebled. Shipments to Europe for the half year just closed amounted to 651,000 tons, as compared with 386,000 tons, or an increase of practically 70 per cent. In the some period, the American consumption has increased 126 per cent.—from 236,000 tons to 534,000 tons. Present stocks in Chili amount to 17 million quintals, against 23½ million quintals a year ago; but it is thought the shutting-down process may soon again be in operation, because of the unremunerative prices to many producers.

THE METAL TRADES IN 1915.

In every branch of trade the conditions during the past twelve months have, of course, been abnormal; and this has been the case to a special degree with regard to all those branches which are directly or indirectly identified with war material. Thus it is that on the present occasion we find Messrs. Bolling and Lowe, in the annual review of the iron, steel, and copper trades, confessing themselves confronted by a series of complicated situations that are unprecedented, but which present a singularly instructive study of the commercial and financial conditions at home and abroad. Hindrances, curtailment of production, dislocated railway transit and shipment, shortage of labour, increased demand in certain directions, and limited sources of supply, have all united to create difficulties for the metal merchant and consumer to an extent never before experienced. Twelve months ago, it was impossible—in the first few months of the war—to say anything definite as to what might be in store; and now, at the beginning of another year, who can have greater confidence in predicting the future of the metal market?

With regard to the present, Messrs. Bolling and Lowe say it is easy to account for the fact that prices of all commodities have reached such a high level. In more than one instance quoted in the report, it is noticed that in a twelvemonth or less the price has been practically doubled; while many articles are from 30 to 40 per cent. dearer—"nor is all this increase unjustifiable," it is remarked, "considering the high rate of wages ruling, and the fact that the enormous Government demands for war material leave only a small surplus available for ordinary requirements." So far from anticipating any reduction in prices while the present state of things continues to exist, rather the contrary, the firm say, may be looked for. It is pointed out, too, as a view which will specially appeal to the shareholders in various industrial companies, that, though it is undeniably a hardship that the consumer should be compelled indirectly to bear so much of the burden of enhanced cost, it must at the same time be borne in mind that this applies also to those manufacturers who during the last two or three years have suffered under a period of reduced profits, and who, when they have an opportunity of recouping themselves, are compelled to surrender a large proportion of their earnings in the form of increased taxation.

Some reference is made in the report to the congestion of the various railway systems which has been a feature of the past year; and the opinion is expressed that the dearth of trucks, the restriction of the employment of those belonging to the various companies to their own respective traffic only, and the trouble in obtaining those belonging to other owners, except for special purposes, as well as the difficulty in getting temporarily disabled waggons repaired, will possibly lead to legislation at a later date, with the view of centralizing control. Attention is drawn, also, to the "singular attitude, probably induced by force of circumstances, taken by the railway companies in connection with shipping." Exports have, of course, been affected by the withdrawal from the market of a large number of merchant steamers; but it seems that the difficulties encountered in getting goods out of the country have been of a manifold character. One of these difficulties has been the refusal of the railway companies to carry goods to the seaports until they had received a definite undertaking that a certain vessel was prepared to receive them on their arrival. Then the shipping companies were not always in a position to guarantee to receive certain goods, but often only signified their willingness to do so in a given time which was insufficient for the railway company to effect the delivery. As is generally known, many regulations have from time to time been published with regard to materials allowed or disallowed to be exported; and it is found that much delay is consequently caused in making application for permits. With all these obstacles in their way, manufacturers in many cases decline to execute orders, or even to commence working on goods, until they receive assurances that, when ready, they can be shipped forthwith, or that they will receive payment when the goods are ready at the works. Speaking of the high freights that have been charged—in many cases four or five times the normal figures, and in some as much as ten times those ordinarily ruling—and the consequent rich harvest many shipowners are enjoying, Messrs. Bolling and Lowe say that there is, however, another side to the picture, and that is where owners have entered into extended time charters, before the war, spread over a number of years, and are now running their boats at heavy loss. There is, further, the serious question of detention; for it is declared that steamers have been known to be detained in London for three months and more, for want of labour in loading and discharging. At the same time, they admit that shipowners will, on the whole, have had every reason to be satisfied with the past year.

As to actual figures quoted, it is stated that pig iron warrants have advanced about 25s. per ton since the last report; and hematite and "makers' iron," considerably more. The war has to a great extent affected the production of rails; many large rolling mills having relinquished making them for the time being in favour of more urgent and more profitable work. There has been a considerable advance in the value of rails; the few works still rolling asking from £11 to £12 per ton, according to specification. The price of copper rose from just under £63 per ton in January to £80 per ton in November; galvanized sheets, from £12 5s. to £24 5s.; pig iron, from 57s. 6d. to 72s.; and joists, from £8 to £12. Tin at the commencement of the year was £168 5s. per ton; and the price fell steadily, until in September it was no more than £150. Since then, however, there has been a recovery to just beyond the opening price—namely, £168 15s. per ton. The figures mentioned are not claimed to be more than approximate.

The review concludes with the customary figures relating to this country's exports of iron and steel, and their values, for the eleven months ending Nov. 30 of each of the past three years. The figures for pig iron are given as follows: Year 1913—1,050,682 tons, value £4,535,759; 1914—748,986 tons, value £2,839,912; 1915—536,725 tons, value £2,983,515. Wrought tubes and fittings: Year 1913—150,303 tons, value £2,718,539; 1914—121,954 tons, value £2,060,771; 1915—95,564 tons, value £1,995,468. The total exports of iron and steel were: Year 1913—4,569,637 tons, value £50,208,580; 1914—3,678,631 tons, value £39,373,157; 1915—2,944,838 tons, value £36,909,103.

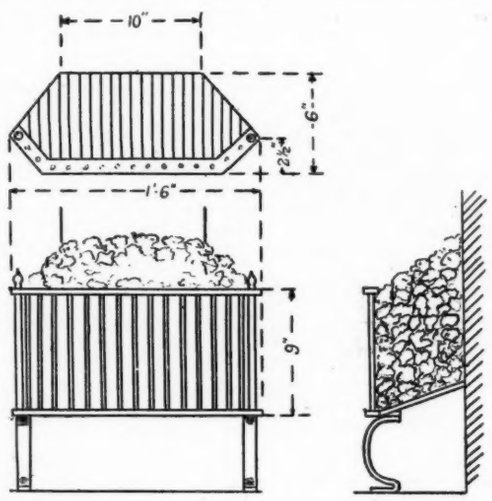
New Year's Honours.—Included among the recipients of New Year's Honours at the hands of His Majesty the King, there are several names well known in the gas industry. Sir Daniel Ford Goddard, M.P. for Ipswich (of the Gas Company in which town he was for fourteen years Engineer and Secretary, and is now Chairman as he is also of the South African Lighting Association, Limited), becomes a Privy Councillor. Sir Daniel, in addition to the chairmanships mentioned, is the Deputy-Chairman of the Tottenham District Light, Heat, and Power Company. Mr. D. A. Thomas, the Managing-Director of the Cambrian Combine and other collieries in South Wales, has been made a Baron. The honour of knighthood has been conferred upon Mr. John Boraston, J.P. (a Director of the South Suburban Gas Company).

OPEN GRATES FOR BURNING COKE.

By "Qui Vive."

A good many people have firmly rooted in their minds the conviction that coke without admixture with coal will not burn in an open grate. This conviction is usually founded upon some unsuccessful experiment of their own or upon that of some friend. It would be quite wrong to state that all coke will burn in all open grates, for this would be far from the truth. But, a great many open grates will burn coke quite satisfactorily; and this article is written with the idea of throwing some light upon a little-known subject.

First of all, it can be asserted with confidence that large coke will not burn in open grates as used in ordinary households. In all cases it must be "broken" coke. Secondly, only those grates which will permit of the coke being piled-up to a height of about 8 inches—10 inches is better—are suitable for the purpose. The modern "well" type of grate is admirably adapted for burning coal; but it is quite unsuitable for burning coke. The fact is, coal and coke require absolutely opposite conditions, if each is to be burnt in a proper manner. Coal should be burnt in a thin layer with a large grate area to allow the air to obtain access to the whole of the fuel. Coke, on the other hand, should be burnt —and indeed will only burn—in a thick layer; while the area of the grate can be quite small provided that the proper thickness of fuel is ensured. This being so, it will often be found that the unsatisfactory grate for burning coal will do very well for burning coke. Coal, if burnt in a thick layer, will require a great deal of poking to break-up the tarry masses of caked fuel, and without constant attention this type of grate gives very poor results with coal. Even so, such grates are not often deep enough to provide for a sufficient thickness of coke, or, to put it in another way, an extra inch or so of depth would make sure of a good coke fire on all occasions, even when the coke is somewhat damp and heavy in ash and the draught poor. The extra two or three inches of depth are a reserve to provide against bad conditions, which sooner or later are bound to be experienced.



To prove the truth of the statement that broken coke will burn satisfactorily in an open grate of sufficient depth, the writer altered the grate in his office, as shown in the accompanying sketch. Since this was done, many months ago, broken coke has proved itself to be on all occasions a most satisfactory fuel, and more consistent one day with another than even coal could be. So long as the fire is kept fairly full by being replenished every hour or so, and the fire-bars cleared of ash two or three times a day, the fire has always been bright and hot.

The drawing here reproduced shows a home-made grate which was fitted into an existing fire-place. The front bars are made of ⅜-inch rod, with a piece of flat steel top and bottom. The floor of the grate may be made of cast iron in the usual manner; and in this case would be arranged on a slope corresponding to that formed by the coke when piled up. But this is unnecessary. It will be noticed that the height of the grate is 9 inches, which works well in practice, while the depth is 6 inches, which is also satisfactory.

To light the fire a special gas-burner, comprising four bunsen jets, is used; but nothing so elaborate is really necessary. If the grate be filled up with coke, and the gas lighted for about 15 minutes, the coke will be well alight. The fire can of course be lighted with wood and coal in the usual way; but gas is more convenient. It is found in practice that 1¼ cwt. of coke will provide a good fire for 48 burning hours per week in an office of moderate size. Except, however, in very cold weather the grate, as now arranged, is rather too large for the office, and would quite well heat a room at least 50 per cent. larger. It is probable that this fire costs not more than about one-half of what it would cost if coal alone were used, which shows that the subject should prove an interesting one to the domestic economist.

It may be stated that on no occasion have any sulphur fumes been noticed, and the atmosphere of the office has been throughout perfectly satisfactory. The writer is strongly of the opinion that the prevailing popular idea that coke cannot be burnt without emitting an undue amount of sulphur is altogether without foundation. A great deal of the original sulphur in the coal is removed at the gas-works in the process of carbonizing; and it is a sure thing that what is extracted with the gas cannot be left in the coke. If the original coal and the coke which it yields be both analyzed for sulphur, it is found that the coal and coke contains about an equivalent amount of sulphur, which goes to prove that there is not much in this bogey. A possible explanation of the popular idea may be that when coal or coke is burning properly, and the products of combustion are passing up the chimney, nothing offensive is noticed in either case; but when burning badly the coal-fire throws out clouds of smoke into the room in which the sulphur fumes, mixed with quantities of other noxious products of combustion, pass unnoticed. On the other hand, coke when burning badly emits its products, which are merely carbonic acid (CO_2) and a small quantity of sulphur dioxide (SO_2), together with minute quantities of other waste products, into the room, with the result that the sensitive nose has nothing to smell but the sulphur, which is accordingly exaggerated out of proportion to its actual amount.

It may be asked, Why must coke be burnt in a thick or deep layer? This may be explained by stating that a piece of coke, unlike a piece of coal, has no burning properties in itself. It contains no volatile matter, or, in other words, gas and tar. When coal is warmed this volatile matter is thrown off, and is ignited should there be any flame or red hot fuel to light it. The coal is then in a condition to burn itself away so long as any volatile matter remains. Coke, on the other hand, is merely carbon with a percentage of ash and moisture, and a carbon fuel of this kind can only burn *en masse*—that is to say, when a large number of pieces are lying in a heap, and in such a form that the requisite amount of air can percolate through the mass and combine with the carbon present to form carbonic acid (CO_2).

The writer has repeatedly noticed that when the broken coke is burnt in a sufficiently deep layer, a flame is seen at the top of the fire, which is not the case whenever the layer is too thin—say, less than 7 inches in thickness. This flame appears so long as the coke at the top of the fire is red hot, and the thickness of fuel is sufficient. In fact, it would seem that the open grate used with broken coke and constructed of an exceptional depth is virtually a small gas-producer, similar in some degree to those used for making producer gas for the driving of gas-engines and for other industrial purposes.

It should be explained that an open grate of this type should be constructed with vertical front bars, so as to allow the coke to fall as the fire burns down. If this be not done, the horizontal bars will certainly cause a hanging-up of the coke, with the result that an excess of air will pass into the centre of the fuel bed, dividing it into two layers; and in this way the essential condition that the fuel must be burnt in a thick layer will upset. Coke, being of an irregular shape and having a rough surface, is very liable to hang-up if given the opportunity; so that this point must not be overlooked when constructing or adapting a grate for this purpose.

It is suggested that ironmongers with an eye to business might offer to adapt existing grates to the design here shown. The expense entailed in altering a grate should not amount to more than could be saved in a few months on the particular grate by the use of coke instead of coal. The exhibition of the arrangement in the shop window, together with particulars of the economy to be obtained, would doubtless cause a good deal of inquiry. People should be reminded that the use of coke dispenses with the chimney sweep; and, further, no smoke or soot is thrown out into the room, nor into the atmosphere.

Exports of Coal.—The Board of Trade announce that a white list of regular and reliable importers of coal in neutral countries has been prepared; and shippers are advised to consult the list before applying for licences to export coal or gas coke to any particular firm, as this may prevent delay in dealing with the applications. It will be understood that licences must be obtained in all cases, whether the name of the consignee is on the list or not, and that the granting of licences is dependent upon the available supplies of coal and coke in this country and the other considerations which have to be borne in mind by the licensing authority.

Coal Tar and its Products.—Last Saturday's "Iron and Coal Trades Review" contained a brief reply, by Messrs. Hird, Chambers, and Hammond, to some remarks made by a correspondent, "Distillation," whose letter was referred to in the "Journal" for Nov. 30, p. 502. The Huddersfield firm write that they set the value of 5d. per gallon upon the total distillates obtained from the tar; but "Distillation" pointed out that creosote oil is quoted at 3¼d. per gallon, which is, of course, correct. But as he evidently intended to convey the impression that the oil referred to—namely, the total distillates from tar—was nothing more nor less than creosote oil, readers should be plainly given to understand that creosote oil is a residuum from coal tar distillates after the whole of the benzol, toluol, phenol, cresylic acid, and naphthalene have been removed. "Distillation" cannot under any circumstances whatever, they say, contradict the figures they gave in their previous communication, and "he will serve no good purpose by attempting to convey the impression that creosote oil is as valuable as the distillates from tar."

SOME USES OF GAS IN THE WAR.

THE title prefixed to the present article is unambitious; but it is ample to go on with. "How Gas is Helping the War" would be a headline for a far bigger chapter than could be produced from any one source in the gas industry—if indeed from the combined efforts of many.

The purpose in view is to deal with one particular aspect of the immense and daily-increasing employment of gas-furnace apparatus in munition works all over the country; but the gas industry is helping not at one point but at many. Scarcely one of the numerous industrial uses to which gas appliances so admirably lend themselves but are called for by the requirements of the war, and always with the most efficient response.

The use of gas for power is invaluable in numbers of places engaged on war work; and the use of gas for lighting—always time-honoured—was never more honoured than just now. Last, and among the most important of all, the bye-products of the gas industry, toluol and benzol, are indispensable to that vital war service of to-day, the manufacture of explosives. One could wish, it may be remarked in parentheses, for a fuller realization by some of the powers that be, that as these two important materials are

Fig. 1.—Group of Shells and Shell Parts, Cartridges, &c.

bye-products of gas manufacture, the output of them is proportionate to the output of gas; and wherever restricted railway facilities, or any other preventable hampering of the business of gas-apparatus manufacturers delays or diminishes their delivery of gas-consuming apparatus to the gas undertakings, this has the effect of keeping-down gas consumption—already reduced by the war lighting restrictions—and therefore also needlessly keeps down the production of toluol and benzol.

The variety of war purposes which gas is at present serving could not be better summed up than in the following excerpt from an official communication issued by the Director of Factory Construction in the Ministry of Munitions to the manager of every munitions factory in the country, strongly urging that, in face of the present need for an increased output of toluol and benzol, and of the shortage of labour, gas should be used as extensively as possible in all munition factories.

PURPOSES FOR WHICH GAS IS BEING USED IN FACTORIES.

As an Illuminant:
- For all purposes. Incandescent burners should be employed in all cases.

As a Fuel (Cooking):
- For the provision of hot meals for employees.

As a Fuel (Water-Heating):
- For the provision of hot water for baths and lavatories and for washing purposes generally.

As a Fuel (Warming Purposes):
- For heating offices by gas-fires, and large rooms by means of gas-heated radiators.

As a Fuel (Manufacturing Processes):
- For the following purposes:
  - Annealing steel and bar for billets in charges of from 2 to 10 tons. Consumption about 3000 cubic feet per ton of steel annealed.
  - Annealing armour-piercing shells (15-inch).
  - Nosing or heading steel-pressed shells.
  - Heating copper bands for shrinking or pressing on to shells.
  - Annealing brass for cartridge making.
  - Welding bayonets.
  - Forging, brazing, annealing, hardening, and tempering parts of small arms.
  - Thermo treatment of steel in connection with gear parts for motor transports and of parts for submarine engines.
  - Tempering and hardening tools.
  - Heating of acids or other liquids in vats.
  - Cloth pressing and tentering.
  - Raising steam in moderate quantities.
  - Melting and casting all descriptions of metals.
- Generally for all purposes involving the use of heat, either by direct application, or through furnace, oven, or internal heater.

As a Source of Power:
- In all size units up to 1000 B.H.P. engines and even larger sizes.

To state here in full the reasons why gas is proving so versatile a servant in war work would be to set forth all the numerous advantages of gas as a fuel—and these are already known to readers of the "JOURNAL." Among the chief virtues which have commended gas to managers of munition factories are doubtless the following: Saving of space, unequalled range of control, labour-saving effect, and elimination of waste—making for greatly increased efficiency. For example, in annealing processes, where coke or other crude fuels are used, a substantial proportion of scrap is unavoidable, whereas wherever a properly-designed gas-furnace is employed waste of this kind is reduced to a negligible point.

It is believed that an interesting light will be thrown on some of the excellent work that gas is doing for the war if we give a number of photos illustrating the variety of ways in which gas apparatus made by one single firm alone is serving the needs of the war, and serving it as well as—and in most cases better than—anything other than gas apparatus could do.

Knowing the unexampled difficulties in shortage of labour, shortage of material, and shortage of transit facilities, one is pleasantly surprised to find that, in spite of all these, the Essex Works, Birmingham, is a hive of bustling activity, and not least in its furnace department. Months ago, the ordinary accommodation of the department became utterly overtaxed, and relief had to be found by making use of ample space in another part of the works, where the larger sizes of gas-furnace apparatus are now being fitted together, tested, and despatched.

Inside the department the pressure is intense and increasing. The departmental technical staff, which, as will be readily imagined, is both numerous and highly equipped, is not only closely occupied with the production of the regular standard furnace apparatus, but its members are in constant request for consultative purposes all over the country. Fresh problems, both chemical and engineering, are continually cropping-up in this

The Uses of Gas in Shell Production.
FUSE CAP.—Sheet-metal annealed in Gas-heated Oven Furnace.
FUSE PLUG, SOCKET and BODY.—Metal melted in Gas-heated Crucible Furnaces. Castings heated in Gas Oven Furnaces before stamping.
"NOSING-IN" TOP OF SHELL BODY.—Open end of shell is heated in specially designed Gas Furnace.
LACQUERING INSIDE OF SHELL TO PREVENT CORROSION BY ACIDS IN EXPLOSIVES.—The Lacquer is dried in Gas-heated Ovens.
BULLETS IN SHRAPNEL SHELL.—Lead melted in Gas-heated Furnace.
ROSIN TO KEEP BULLETS IN PLACE—Rosin melted in Gas Melting-Stove.
COPPER BAND SHRUNK ON TO SHELL BODY, which by engaging with the rifling-groove inside the gun stops the passage of the gases, effects the rotation of the shell, and keeps the shell-body from contact with the barrel. Annealed in Gas Oven Furnace.
SOLID BILLETS USED FOR MAKING SHELLS.—These are raised in Gas-heated Furnaces to the needful temperature for the successive forging operations by which they are hollowed and shaped into shell form.
THE SHELL BODY is treated in a Gas-heated chemical bath to ensure due tensile strength.
BRASS SHELL-CASE.—This is annealed in Gas Oven Furnace before each successive drawing operation.
IN BORING, TURNING and SHAPING SHELL-BODIES, High-speed-steel tools are used, and these are heated and tempered in Gas-heated Furnaces.
Gas-heated Mixers are used in Chemical Works connected with the manufacture of explosives.
Section of Shrapnel Shell.
Section of High-Explosive Shell.

Fig. 2.—Diagram Showing the Uses of Gas in Shell-Production.

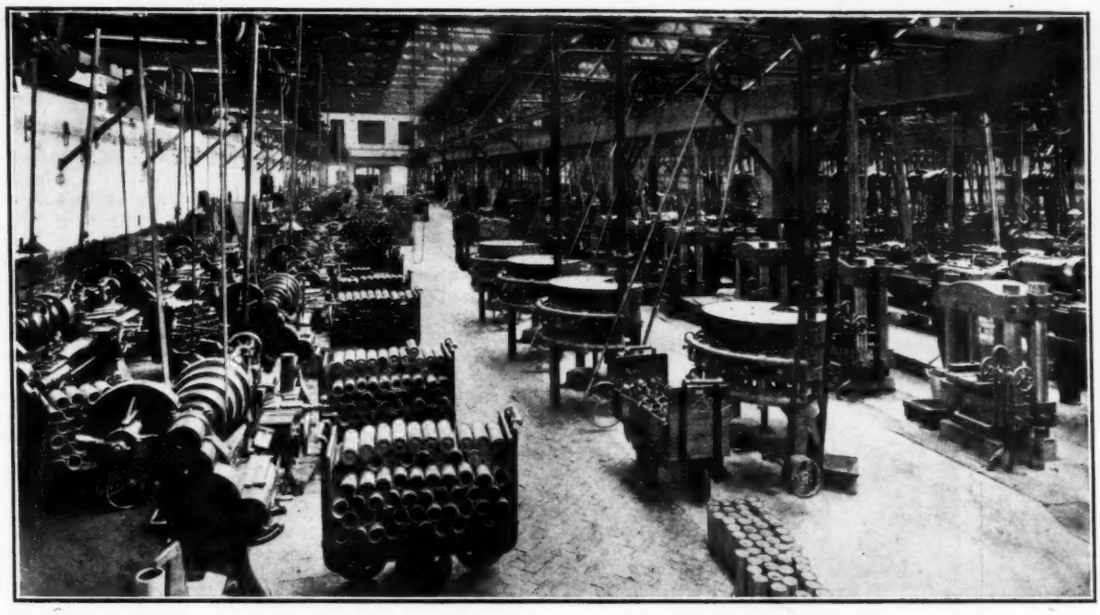


FIG. 3.—A BUSY MACHINE SHOP IN A MUNITION FACTORY.

and that munition factory. New devices have to be contrived to meet these fresh calls on the ingenuity and resource of the staff. These have never been found wanting, but have always proved fully equal to the demands of the occasion.

Projectiles of all kinds and sizes, from the small cartridges for the service rifle right up to great 15-inch shells for naval guns, owe certain of the processes of their manufacture, and often

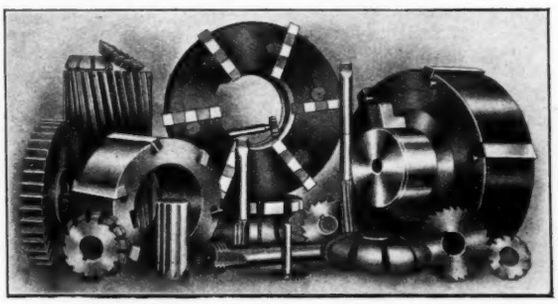


Fig. 4.—Cutters and Other Tools for High-Speed Machine-Work.

nearly all of them, to the use of gas apparatus made at the Essex Works. A walk round the works shows a great quantity of such apparatus in all stages of construction; and the total output of their gas-furnace department for war purposes is such as, we learn, would be found to be a most startling figure, were it permissible to make it known.

The accompanying two-shell diagram well repays examination, as an index to the pictures which follow, and, indeed, as an epitome of much of the war work which the firm's gas apparatus is accomplishing throughout the country. It is difficult to realize that so many operations are required in the turning-out of these death-dealing contrivances, and that, through the medium of the Essex Works, every one of these operations is being regularly performed by gas apparatus.

The modern shell, whether it be of the shrapnel or of the high-explosive variety, is a complex and delicate instrument, which must be made as carefully and timed as accurately as a chronometer. Wanting this accuracy, it may be too dangerous at the beginning of its journey and too safe at the end. It may kill friends; and it may fail to kill foes. A very little distortion, for instance, through the merest irregularity in one of the numerous heating processes in its manufacture, or a slight excess of hardness or softness in the encircling copper ring, due to a minute inexactitude in annealing, would affect the direction of the shell and might seriously damage the gun. A very slight flaw in some part of the fuse might mean that the shell would burst too soon, or that it would not burst at all. In respect of its contribution towards the avoidance of such irregularities, gas heating, with its steady uniformity of action and effect, is the obvious perfection of means adapted to ends; and the Essex Works shell-furnaces have been so contrived for conserving every advantage of this uniformity, that it is small wonder no shell manufacturer who can get them—whether in Government factory or private works—will be content with other furnaces employing cruder fuels.

The uses of gas in this connection do not, however, end with the shell—indeed, it may be said that they do not begin with it either. Let the reader picture a vast and splendidly equipped shell-manufacturing establishment, such as the representative factory "Somewhere in Britain," which is shown in fig. 3—the firm's rotary gas-shell furnaces will be seen prominent in the fore-

FIG. 5.—A BATTERY OF HIGH-SPEED-TOOL GAS-FURNACES IN POSITION IN A MUNITION FACTORY.

ground—and let him ask himself what must happen with all the fine high-speed tools that are in use in such a factory, as after regular wear and tear, they from time to time require restoring to working condition.

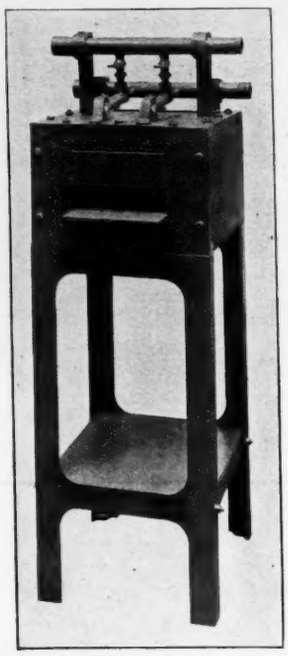


Fig. 6.—A Gas-Forging Furnace for Some Classes of Munition-Making Tools.

In the hands of the toolmakers, who may be called the ambulance corps of the army of munitioners, those vast numbers of tools which are rendered temporarily *hors de combat* are, by the use of Wright-Brayshaw high-speed-tool gas-furnaces, speedily restored to the ranks of the effectives once more. Indeed, some of the largest makers of munitions in the kingdom have standardized on the firm's high-speed-tool furnaces—just as some gas undertakings do on their gas-stoves. These munition makers buy the furnaces from the firm in batches; and they highly value the reliable uniformity and other great conveniences resulting from their standardizing on this one make of apparatus.

Fig. 6 illustrates a gas-forging furnace such as is used in the earlier processes in the career of certain classes of tools. In these furnaces, to begin with, the metal of which the tools are to be formed is heated, in order that the preliminary operation of shaping may be carried out.

Coming to brass cartridge cases, the furnaces in which these are annealed are by no means small or light; and it illustrates the huge scale upon which everything in this war is conducted that these furnaces should actually be commonly referred to in dozens. One large munition firm, for example, has fitted up about three dozen of the firm's gas annealing furnaces, specially designed for annealing the cartridge cases for the Army-service rifle; and with the help of these they are turning out many millions of cartridges every week.

We remarked that in the Essex Works furnace apparatus gas was doing much war work better than any other fuel; and a most interesting example of this betterment is the heating of cartridge clips for the rifle cartridges to which reference has just been made. In large munition works it has been found that Wright's 6-ft. by 4-ft. gas-furnaces take 33⅓ per cent. more cartridge clips (twelve boxes instead of nine) as compared with a coal-fired furnace of similar size. This is due to the uniformity of temperature which the gas-furnace maintains. In the coal-fired furnace, owing to what is termed "cold-mouth" of the furnace, the boxes of clips could not be placed within 18 inches of the door—a restriction which is entirely done away with in Wright's gas-furnaces. These gas-furnaces also reduce the time that the clips have to spend in the furnace by a further 33⅓ per cent.; so that between these two savings the output is almost doubled. Another point scored by the gas-furnaces is that three of them occupy only the same space as one of the coal-fired variety, with its indispensable coal-storage space, which is not called for with gas. Hence these munition makers have actually multiplied their output on the same floor-space six times over by installing Wright's gas-furnaces.

Fig. 7 shows pictorially the sixfold economy effected by gas in the treatment of cartridge clips.

Fig. 8 is a photograph showing, in position in the munition works, the gas-furnaces which have superseded the coal-furnaces in the manner described. These same furnaces are also used for the annealing of sheet brass for munition purposes, as well as for annealing cartridge clips.

In fig. 9 is shown one of the "Glory-Hole" furnaces, as they are called in munition works, which the firm supply for use in connection with the "nosing-in" process as applied to the largest sizes of shells, from the 3·3-inch and 4·5-inch up to the 15-inch. This particular furnace actually heats, at one charge, four of the huge 15-inch shells which have done so much to maintain the supremacy of the British Navy. The illustration strikingly brings home to one how effectually gas is helping the war at sea as well as on land.

A "Glory-Hole" Furnace used for "nosing-in" smaller shells in munition factories is shown in fig. 10. The hydraulic press with which the actual "nosing" is done, after the nose of the shell has been heated in the furnace, appears at the left-hand side of the photograph.

Another process in shell manufacture is the lacquering of the interior, in order to prevent the metal being corroded by the chemical action of the explosive materials with which it is filled. The lacquer having been applied, the shells are placed in ex-

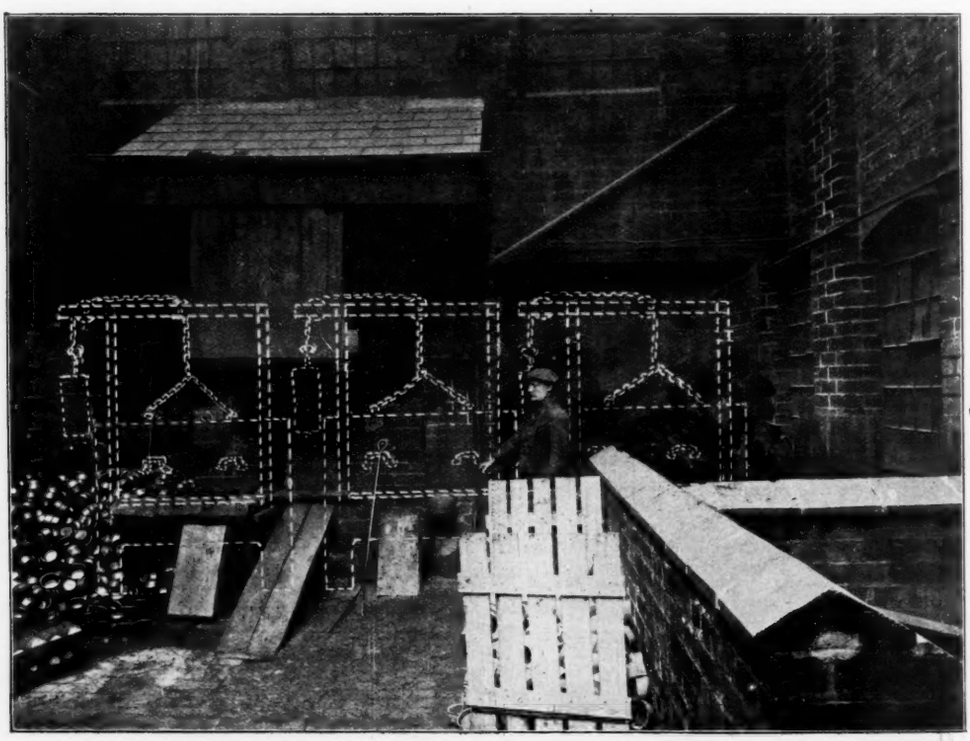


FIG. 7.—SHOWING HOW GAS-FURNACES DO SIX TIMES THE WORK OF COAL-FURNACES.

FIG. 8.—THE GAS-FURNACES THAT HAVE SUPERSEDED THE COAL-FIRED TYPE.

ternally-heated gas-ovens for drying. Fig. 11 shows one of the Essex Works gas-furnaces being used for lacquer drying, with four 15-inch shells in the trolley. The presence of the workman indicates how enormous these shells are.

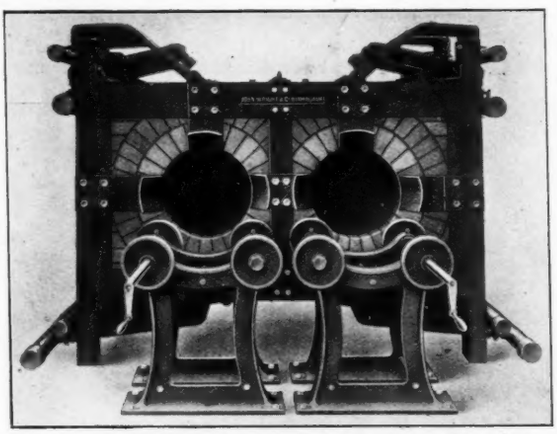


Fig. 9.—A "Glory Hole" Nosing Gas-Furnace for Fifteen-Inch Naval Shells.

Great importance is attached at the Essex Works to the various types of crucible furnaces in which the firm have specialized. These are of all sizes, and capable of smelting from the smallest quantities of metal up to a very heavy daily melt.

Messrs. John Wright and Co. early recognized the exceptionally great possibilities of industrial gas apparatus of the crucible-furnace type; and exceedingly large as their business was in that class of apparatus, they believed that in the then existing types there were certain inherent limitations which must be got rid of before gas melting-furnaces could generally take the place of the coke-fired variety. Due experiment and research produced their present form of crucible furnace, which is now in so wide use, and with which metal can be melted so economically that the cost of the day's run does not exceed 2 to 3 feet of gas per pound of metal melted. It is also found that the life of both the crucible and the furnace is greater with this apparatus than with the coke-fired furnace, and that the loss of metal due to oxidization is considerably less than half that which is inseparable from coke firing.

Fig. 12 shows one of the applications of the firm's crucible furnaces to shell manufacture, in which fourteen of their crucible tilting furnaces and a battery of thirty of their fixed crucible furnaces are installed in one shop in a munition factory, melting white metal for shell fuses. The amount of metal melted by this installation of gas-furnaces in a day is over two tons. Owing to it being found impossible to get Government permission to reproduce the photograph originally intended for this particular portion of the article, we show an installation of thirty furnaces and fourteen tilting furnaces under one roof, but with an altered background, so as to prevent the surroundings being recognized.

Messrs. Wright and Co. supply a type of gas-heated lead bath (fig. 13) which is used for a heating-up process in the manufacture of certain types of shells.

Brass tube of various sizes is naturally in use for an equal variety of purposes in the manufacture of munitions; and for the annealing of these tubes a special gas-furnace has been designed and supplied by the firm, as illustrated in fig. 14, in order to give absolute uniformity of annealing the entire length of the tube.

Fig. 15 shows a gas-furnace which has been specially made for tempering the entrenching tools with which certain sections of our Army are now furnished.

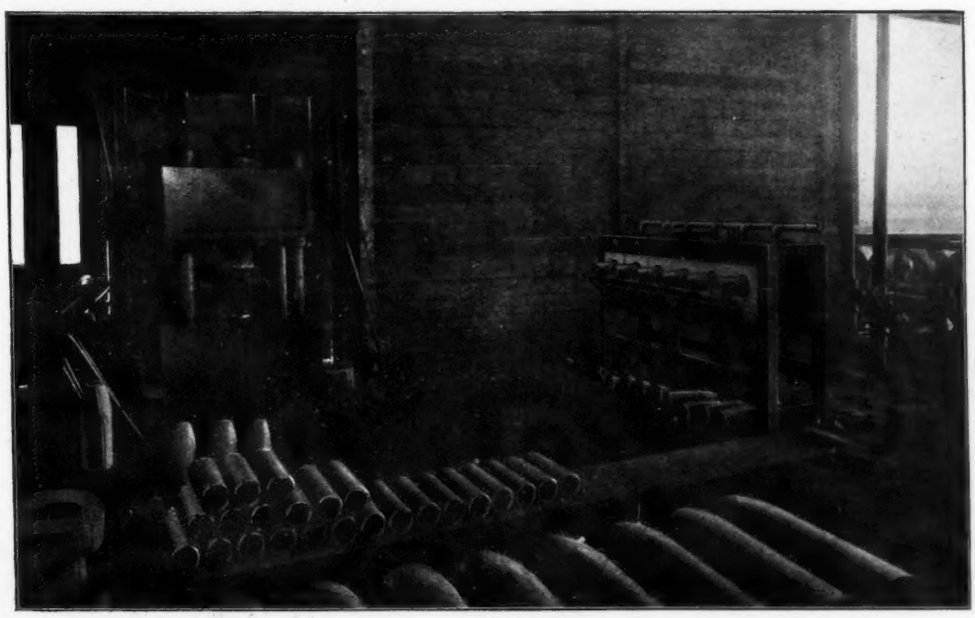


FIG. 10.—A SMALLER TYPE OF NOSING GAS-FURNACE IN POSITION IN A SHELL-FACTORY.

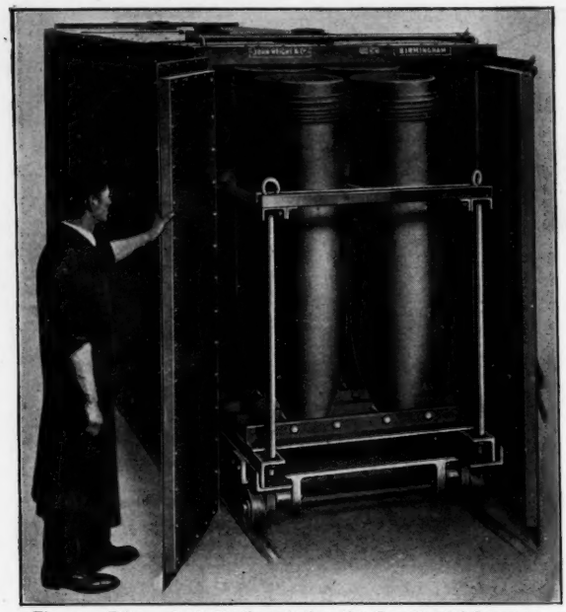


Fig. 11.—Fifteen-Inch Shells entering the Gas-Heated Lacquer-Drying Furnace.

War uses of the Essex Works furnaces are by no means confined to the manipulation of metals. Furnaces of suitably modified construction have also gone from this establishment to glass manufacturers for processes in connection with glass apparatus for war purposes.

The large machine which is being handled by a workman in fig. 16 is one of a number which Messrs. Wright and Co. have supplied for use in chemical works, in connection with the manufacture of explosives for munitions. The apparatus consists of a very large gas-heated vessel (having agitator machinery inside) for the mixing of certain materials connected with these explosives. There being such a dearth in the labour market at present, work in operating this machine is minimized by its being so constructed as to tilt over to the side for emptying purposes.

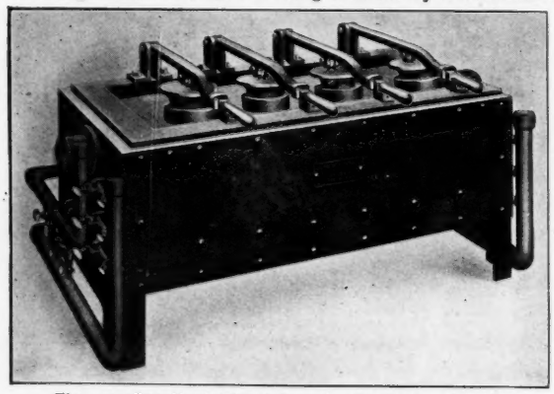


Fig. 13.—Gas-Heated Lead Bath for Shell Manufacture.

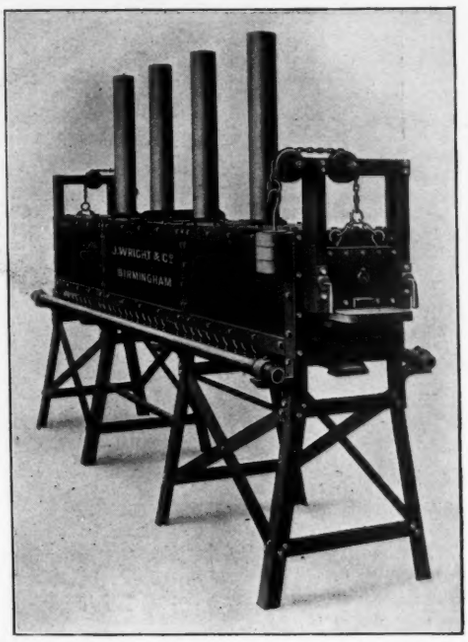


Fig. 14.—Annealing Gas-Furnace for Brass and Copper Tube.

FIG. 12.—A BATTERY OF GAS CRUCIBLE-FURNACES—FOURTEEN TILTING AND THIRTY FIXED—AS INSTALLED IN A LARGE MUNITION FACTORY.

It has been remarked that Essex Works war apparatus has not been confined to the treatment of metals, and, indeed, it is by no means limited to facilitating the production of contrivances for damaging the enemy. Apparatus not less effective is also being furnished from the same works for promoting the creature comfort of our own soldiers. The sudden converting of the whole country into one great Arsenal involves the erection of brand new munition factories and the conversion and extension on a large scale of existing factories. For the great concourse of additional workers with which these vast, newly-equipped munition factories are being manned, means have to be improvized for the supply of meals, as in many cases no such arrangements exist. Here, again, the variety of gas-cooking apparatus which the Essex Works are in a position to furnish has been recognized as offering facilities of the most elastic kind for every varying scale of need; and for the supply of such requirements this section of the firm's establishment has been kept working at high pressure since a very early period of the war.

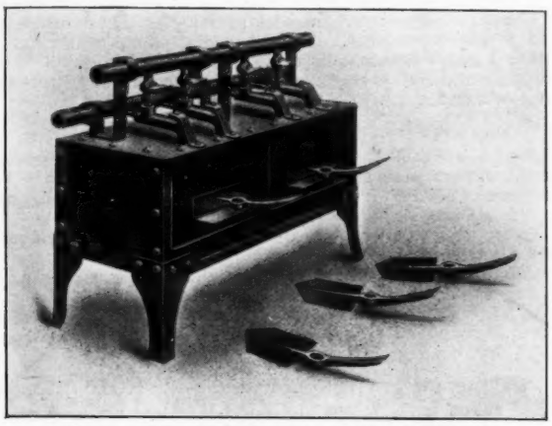


Fig. 15.—Furnace for Tempering Entrenching Tools.

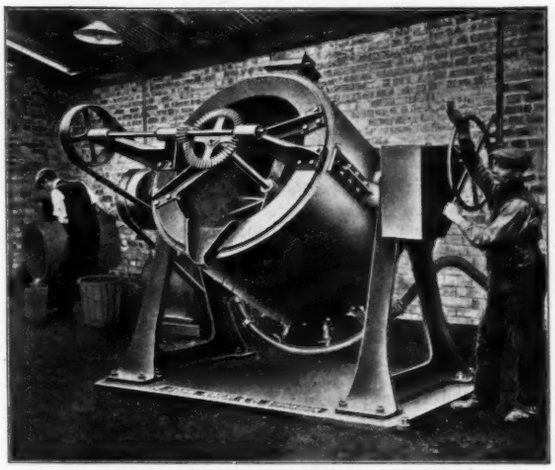


Fig. 16.—Gas-Heated Tilting Mixer for Explosives.

While we are dealing with the matter of kitchens, fig. 18 may also be referred to, as illustrating similar provision for the wants of soldiers in camp, in the shape of a camp kitchen which has been fitted with suitable apparatus from the Essex Works.

Recounting on the fingers of one's hand, so to speak, the salient points of what has been ascertained from a most instructive review of the Essex Works war apparatus, we find that the munition-making tools are prepared and repaired by the help of gas-furnaces; the shells at nearly every process are treated by gas-furnaces; the rosin and lead for the bullets for filling the shells are melted by gas; the lacquer inside them is dried by gas; trench tools, with which our men "dig themselves in," are tempered by gas; the camps where they live, and the hospitals where they convalesce, are heated by gas; the food they eat is cooked by gas; and the very uniforms they wear are not free from obligation to the all-round utility of the same medium.

In short, whether the material to be treated be mineral or vegetable, or whether, indeed, it be animal in the shape of food, gas is proving itself to be the most convenient medium for the purpose; and when we add to this the fact that the gas industry is providing one of the most essential of present-day war materials, gas men of all varieties have every reason to feel that gas never more fully vindicated its high place in modern industry than it is now doing in the great war.

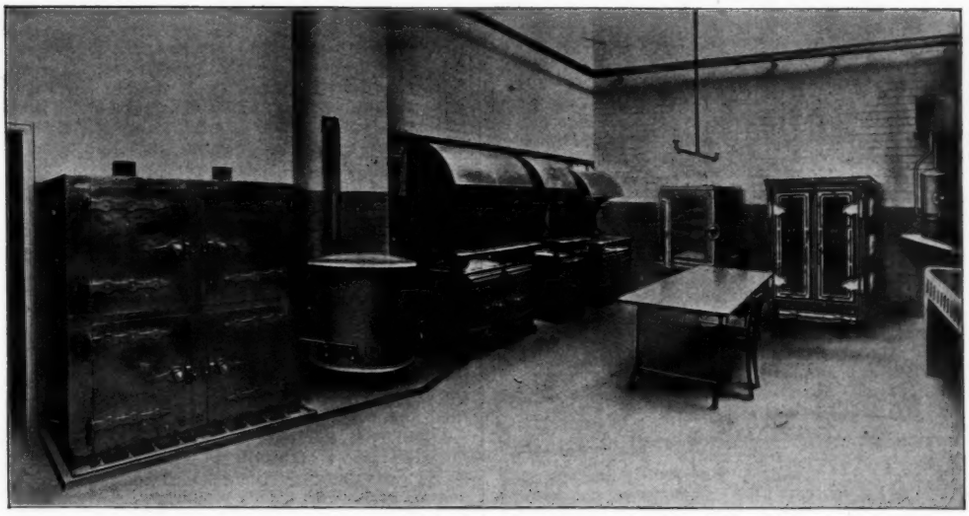


FIG. 17.—KITCHEN OF A MUNITION FACTORY, WITH GAS APPARATUS THROUGHOUT.

FIG. 18.—KITCHEN OF A MILITARY CAMP, ALL THE APPARATUS IN WHICH IS GAS-HEATED.

BYE-PRODUCTS OF CARBONIZATION.

By Burton Dunglinson.

Shortly after war was declared, industrial Britain began to realize how much she was dependent on German commodities, particularly artificial dye-stuffs. Then came the explosives question, and the maintenance of an adequate supply of high explosive shells, for a rapidly increasing army. These two problems were tackled in a businesslike manner; and, thanks to our engineers and scientists, we now find ourselves in a position of security, with only the problem of raw material to trouble us.

Most dye and explosive factories are dependent on their regular supply of benzol and toluol; but I wonder how many gas engineers and coke-oven managers are acquainted with the treatment meted out to their tar and benzol before it is placed on the market as an explosive or dye-stuff. I do not propose to disclose works secrets, but to provide a short résumé, dealing with the building-up of an explosive and dye, using tar as a starting point.

When the tar arrives at the distillation works, it is usually placed in a large stock tank, where it is pre-heated, and so freed from excess water before entering the still. The first runnings of the distillation (light oil) are collected as one fraction, boiling between 40° C. and 150° C. This oil, contains most of the benzene and toluene, but requires special treatment before being despatched to the explosive manufacturer. The fraction above the light oil, known as carbolic or middle oil, is worked for phenol. This is recovered by washing the oil with a weak caustic soda solution; and subsequent decomposition of the sodium salt, with either carbonic acid or dilute sulphuric acid, yields phenol. This liberates the phenol *plus* cresols, which are separated by fractionation, and the former is then concentrated. Although the supply of phenol recovered in this manner is ample for the world's requirements in normal times, owing to the enlarged demand in war time the quantity of natural phenol is insufficient. This insufficiency necessitates the adoption of other measures to provide supplies to meet the demands, and synthetic phenol is brought forward.

Before any military explosive can be manufactured, the pure, raw product must be obtained; and our attention is diverted to the manufacture of pure benzene and toluene. The conversion of the crude material into the various commercial products is ordinarily effected by rule-of-thumb processes, devised without any adequate preliminary study of the nature of the compounds dealt with, and without recognition of the scientific principles by which the manufacturer should be guided. Crude benzol contains a host of impurities, all of which are detrimental to the manufacture of a good explosive; and these must be eliminated previous to the isolation of the pure compounds. The impurities commonly met with are appended below, with their approximate percentage in a crude 65's benzol. The yield of unsaturated, aromatic, and paraffin hydrocarbons can be estimated in the following manner, devised by Drs. Dunstan and Thole, from various mixtures of paraffins, benzene, toluene, hexamethylene, and olefines of known composition, and the results agreed to 1 per cent.

Estimation of Unsaturated Hydrocarbons.

For this purpose, 50 c.c. of the crude benzol is shaken with about 20 c.c. of 95 per cent. H_2SO_4 for two minutes and allowed to stand for ten minutes, when the decrease in volume is read. This represents the amounts of unsaturated bodies.

Estimation of Aromatic Hydrocarbons.

The unattacked portion from the above experiment is treated with 25 c.c. of fuming sulphuric acid, containing 20 to 30 per cent. of SO_3. This must be done cautiously, as considerable heat is generated, and cooling may be necessary. After shaking for ten minutes, allow to stand until separated, and the decrease in volume is again noted. This represents the yield of aromatic hydrocarbons. Paraffins and hexamethylenes are unattacked by these acids, and are therefore estimated by difference.

Composition of Crude 65's Benzol (approximate).

	Per Cent.		Per Cent.
Unsaturated bodies	1·0	Thiophene	0·5
Aromatics	90·5	Mercaptans and thio-ethers	0·5
Paraffins, &c.	3·0	Hydroxy-compounds	2·5
Carbon disulphide	2·0		

The crude benzol is usually treated with 98 per cent. C.O.V. to remove the greater proportion of the impurities. The orthodox method on the Continent is to fractionate the light oils into essential components, and wash afterwards. In small works, it is customary to wash the whole of the crude benzol, and fractionate later. The reactions with concentrated sulphuric acid are very complex, but are of interest, and perhaps altogether new to some readers. Where the oil is treated with caustic soda first, some of the sulphur compounds are dissolved, and all the phenol and homologues recovered.

Thiophene (C_4H_4S).

This has a specific gravity of 1·07 and boils at 84° C. It greatly resembles benzene; and on treating it with concentrated sulphuric acid forms a brown solution, containing a sulphonic acid. This slowly decomposes, forming H_2S,SO_2, and an amorphous precipitate of free carbon.

Unsaturated Bodies (C_nH_{2n}).

These include ethylene and its homologues, dihydrobenzenes, and tetrahydrobenzenes. Concentrated sulphuric acid forms an additive body—a sulphonic compound, which is soluble in the benzol, and therefore requires thoroughly washing out with water after acid treatment.

$$C_nH_{2n} + H_2SO_4 = C_nH_{2n+1}OSO_2OH.$$

These bodies react with violent evolution of heat, and this increase of temperature tends to sulphonate the aromatics; hence the importance of adding the acid in small quantities, where these compounds are present in appreciable amount.

Aromatics are only slightly attacked by concentrated sulphuric acid; but the reaction is more rapid at the higher temperatures. Paraffins and hexamethylenes are unattacked by sulphuric or fuming acid. Carbon disulphide is not attacked by sulphuric acid, but is suitably removed by agitation with alcoholic potash, which forms potassium xanthate.

$$CS_2 + C_2H_5OK = C_2H_5O.CS.SK.$$

Mercaptans and Thio Compounds—R.SH and $(R)_2S_2$.

The mercaptans present in crude benzol are probably ethyl, propyl, and phenyl, with a possibility of the higher homologues in small quantities. The mercaptans have slightly acid properties, and are readily oxidized, forming the thio-ether. Cold sulphuric acid does not dissolve these sulphides, but, on warming, sulphur dioxide is given off.

Phenyl mercaptan has a boiling point of 168° C., and on adding concentrated sulphuric acid, forms a violet solution, changing on warming through red to blue. It is readily oxidized to thiophenol. Most of these compounds form the sulphones, which are soluble in the aromatics left behind; and therefore a good water washing, after acid treatment, is desirable to eliminate them, as they yield sulphur dioxide on heating. The benzol is treated with caustic soda solution before passing to the still for fractionation. When testing benzols in the laboratory, and cooling is resorted to, to prevent sulphonation, an emulsion is often formed on shaking up with water, after acid treatment. The emulsion is the result of surface tension, and can often be broken by adding a drop of ethyl alcohol, which causes a change in the affinity and less cohesion. A crude 65's benzol will yield on the commercial scale, with an efficient column and dephlegmator and careful distillation, about—

40	per cent.	benzol	containing nearly	3	per cent. toluene.
25	,,	toluol	,, ,,	90	,, ,,
8	,,	solvent naphtha	,, ,,	5	,, ,,

Previous to the benzol being worked on the large scale, it should be valued in the laboratory; and here we find difficulty in obtaining similar conditions to the commercial methods, chiefly in the column, which always lacks the dephlegmator. I have made experiments with various columns, and find that the majority are inefficient, and all would be improved if worked in conjunction with a small spiral condenser on top of the column. The amount of water flowing through the condenser can be regulated to give the requisite temperatures for a complete fractionation. Where this cannot be used, lagging the column with an asbestos shield for the higher fractions is very helpful. Laboratory results give the total yields of products obtainable, together with working losses; and these are sometimes difficult to obtain from the commercial scale figures.

Experiments with Different Columns.

Number of Fractionations Necessary for the Complete Separation of Benzene and Toluene.

Young and Thomas twenty-bulb "Rod and Disc"	10
Gan's (Galician column)	8
Le Bel Henninger five-bulb	7
Young's "Evaporator," three-bulb	3

In the above experiments, 1 litre was used and distilled at one drop per second, collecting in 5 c.c. fractions. On a commercial scale, the rate of flow is about 3 per cent. by volume of the charge per hour; and if the plant is efficient, two fractionations are quite sufficient to separate the pure benzene and toluene.

Manufacture of Synthetic Phenol.

The benzene needed for this product must distil over between 80° to 82° C., and should only contain just traces of sulphur compounds, as these substances interfere with the sulphonation and subsequent fusion. The process is completed in about eight stages, and if done in the laboratory an electric motor and stirrer is invaluable—the operation taking only about four hours, against twelve hours when shaken by hand. The benzene must be free from all impurities, which decompose with sulphuric acid, otherwise the product will darken, due to the forming of free carbon and resinous bodies. These decompose the acid, with evolution of sulphur dioxide at high temperature.

Sulphonation.

The reaction here is: $C_6H_6 + H_2SO_4 = C_6H_5SO_2OH + H_2O$. Excess acid must be added to absorb the water formed, and two parts of C.O.V. to one part of benzene by weight is usually sufficient. The amount is comparatively large, as its affinity for water is determined by the evolution of heat on reacting with it. The curve produced jumps up rapidly on the addition of the first few per cent. of water, but settles down to a gradual incline after this point. The first operation consists in running the acid into

the sulphonation pan or kettle, and the benzol is added later on. The kettle is connected to a return condenser, and the contents agitated by means of revolving blades. The temperature of the mass rises, and is maintained at about 80° C. by means of steam passing through an outer jacket. The sulphonation is usually finished in about six hours, and care should be taken to stop at the correct time, and so prevent the formation of benzene disulphonic acid. If too much acid has not been used, the crystals of the benzene mono-sulphonate settle out on cooling. The resulting compound is run into water, and converted into the calcium salt by milk of lime.

$$2C_6H_5SO_2OH + Ca(OH)_2 = Ca(C_6H_5SO_2O)_2 + 2H_2O$$

The excess of sulphuric acid combines with the calcium hydroxide to form calcium sulphate; and this is recovered by filtration. The liming operation is followed by means of litmus paper, and when the mass is nearly neutral calcium carbonate is used to finish the reaction. The soluble calcium salt is recovered by means of filter presses, and is then converted into the sodium salt by means of soda ash. The point at which no more soda ash should be used is determined by the absence of a precipitate, when a small amount is added. The precipitated calcium carbonate can be used for neutralizing the sulphonation mixture.

$$Ca(C_6H_5SO_2O)_2 + Na_2CO_3 = 2C_6H_5SO_2ONa + CaCO_3$$

The solution of the sodium salt can be evaporated by any suitable means; and before alkaline fusion it must be perfectly dry. The yield of the sodium salt is about 90 to 95 per cent. The salt is now ready for alkaline fusion, when the sulphonic radicle is replaced by the hydroxyl group. This is usually done in an open boiler or pot, with suitable stirring gear. If the operation is performed in the laboratory, an ordinary wrought-iron blank coupling suffices; and the melt is stirred by means of a hollow glass tube, sealed at one end and containing a little mercury, with the thermometer just dipping in the mercury. Care should be taken in stirring, as the caustic soda "spits." Also the temperature must be regulated very carefully; for too low a temperature gives no reaction, and too high a temperature decomposes any phenol formed. The caustic is melted first, with the aid of a little water. When the temperature approximates to 250° C., the sulphonate is added, and the temperature gradually raised to 300° C.—the higher limit being 320° C.

$$C_6H_5SO_3Na + 2NaOH = C_6H_5ONa + Na_2SO_3 + H_2O.$$

Excess of caustic is always used, in quantity three to four times the sulphonate, by weight. The melt is generally complete when bubbling stops and the liquid becomes thin. If a great excess of caustic has been used, a separation into two layers takes place, and can be distinguished by the different colours of the sodium phenolate and caustic. The resulting mass is dissolved in water, and the phenol liberated by means of dilute sulphuric acid, CO_2, or HCl. The phenol is separated, and air blown through to free it from sulphur dioxide. The resulting mixture is now fractionated in a still with a column so as to separate the cresols, which boil at 188° to 200° C.; while the phenol boils at 182° C., and the pure product melts at 42° C.

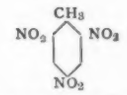
Picric Acid.

Picric acid is tri-nitro-phenol; and the next problem is to introduce these three nitro groups into the benzene nucleus. This cannot be accomplished in one operation, and picric acid can be made either from phenol or dinitrobenzene as a starting point. The first method consists in nitrating phenol sulphonic acid, keeping the temperature at about 15° C. while running in the acid, and gradually increasing it to about 80° C. toward the end of the operation. The mixture must now be kept away from all except the precious metals; and after diluting with water the crystals separate out—being only slightly soluble in water. The second method uses dinitrobenzene as the starting point. This is chlorinated to dinitrochlorbenzene, and the chlorine atom replaced by heating with caustic soda, and then further nitrated to picric acid. Picric acid, as manufactured commercially, is a reddish yellow, large crystal, containing traces of dinitrophenol. It is supplied to the shell filling factories with about 10 per cent. of moisture, and is fused into the shells. It is usually detonated with mercury fulminate.

Trinitrotoluene.

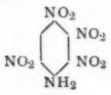
There is practically no information regarding the large scale preparation of "T.N.T." in either British or Continental literature, although no secret is made of the materials used. T.N.T. requires a very pure toluene for its manufacture, and when distilled through a column flask, no more than 0·5 per cent. should come over at 110° C., and all distil over at 111·5° C. The reason why such a pure toluene is necessary is justified when explosive values are being calculated. If a small percentage of benzene is present, nitrobenzol is formed, which dissolves the T.N.T., and so prevents a sharp crystallization. The nitration of toluene is generally conducted in two operations—either the mono- or di-derivative being formed first. A mixture of sulphuric acid and water *plus* nitric acid is made, in the proportion of 6 : 1 : 2 by weight. This is added to the toluene in the proportion corresponding to one molecule of nitric acid to one molecule of the toluene.

The mixture is agitated by means of a motor and suitable stirring gear, and heated to 80° C. for about three hours. The M.N.T. is separated, and a mixed acid, made of 15 parts of 98 per cent. C.O.V. to 4 parts of concentrated nitric acid, is added. One part of the M.N.T. is used to 7 parts of the mixed acid, and the temperature is gradually raised from 70° to 120° C. in three and a half hours, and then kept at 120° for two hours or longer, as the setting point of the T.N.T. necessitates. This should be 82° C., and is tested by withdrawing a small quantity of the nitrating mixture and throwing it into water while stirring rapidly. The T.N.T. separates out and can be dried, and a setting point determination carried out. The acids are run off while still hot, and the T.N.T. is led into water and stirred vigorously to free it from acid. After allowing to settle, it is again washed with water and finally recrystallized from alcohol. T.N.T., when it is pure, is a colourless, crystalline compound, with a melting point of 81·5° C.; but it is usually slightly yellow in colour. Although heat is not liable to explode it, it is advisable, when dealing with this material, to melt it in hot water. T.N.T. must pass stringent tests, both chemically and physically, before it is used for shells. It must have a sharply-defined melting and softening point, a small percentage of ash, with a limited acidity. It is generally melted, and filled into shells, in order to increase its specific gravity. It has the formula:



Tetra-nitro aniline.

This was discovered by Dr. Flurscheim, and has the unique position among explosives of having been discovered in this country. It is less sensitive than picric acid, and offers many advantages as an explosive. A good detonator is prepared by using a mixture of T.N.T. and T.N.A. It is prepared by the action of concentrated sulphuric acid and a nitrating agent upon metanitraniline; the latter substance being made by reducing *m*-dinitrobenzene with H_2S in ammoniacal solution. One part of *m*-nitroaniline and three parts of a nitrating agent are dissolved in 36 parts of concentrated sulphuric acid, and the mass heated to 70° C. Cooling is now applied, to prevent further rise of temperature, after which the mixture is heated to 100° C. for a few minutes, and tetranitroaniline isolated by pouring on ice. It is recrystallized from nitrobenzene, and has a melting point, with decomposition, at 216° to 222° C. It is a golden crystalline substance, and has the formula—



Dyes.

In manufacturing synthetic organic dyestuffs, a large number of products obtained from coal tar are used as raw materials; but our work is limited to benzene and naphthalene as the starting points. When benzene is nitrated at about 60° C. mononitrobenzene is formed, and this, on reduction, yields aniline. Aniline was discovered in 1826 by Unverdorben, and was one of the dry distillation products of natural indigo. It was isolated from coal tar by Runge; but it was only prepared by reduction of nitrobenzene in 1842. The commercial preparation consists in reducing nitrobenzene by means of iron filings and HCl in a closed vessel. While reduction is proceeding, great heat is evolved; and this necessitates the use of a condenser leading back to the still, to condense the volatilized aniline water. When the reduction is completed, the acid is neutralized with lime or caustic soda and the aniline recovered by steam distillation.

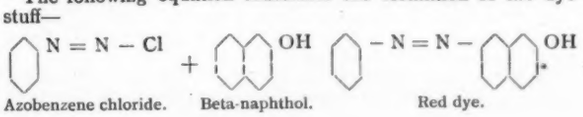
It is a colourless liquid when pure, and boils at 182° C. On treating the salt of a primary aromatic amine with nascent nitrous acid, the diazo-compound is formed. The salt of the primary aromatic amine may be made by adding HCl to the aniline, and either isolating and redissolving or leaving it in solution. The aniline "salt" is now "azotized" with HCl and sodium nitrite, using three or four equivalents of the acid. The temperature must be kept very low; and after the HCl is added in bulk the sodium-nitrite must be added very slowly, while still maintaining the temperature at 0° C. and stirring constantly.

$$C_6H_5NH_2 + HCl = C_6H_5NH_2.HCl.$$

$$C_6H_5NH_2.HCl + NaNO_2 + HCl = NaCl + 2H_2O + C_6H_5.N = N.Cl.$$

If the diazotized chloride is now "coupled" with either a phenol, naphthol, or an amine, a dye is formed. Using naphthol (beta) in alkaline solution, a red dye is produced on stirring with the above azobenzene. All quantities must be calculated from molecular weights, excepting where other directions are given. The red dye, called azobenzene-beta-naphthol, is recovered by filtration and dried in a steam oven, when it is powdered fine and mixed with sodium sulphate and other diluents to bring it to the "commercial standard"—*i.e.*, give a particular shade to a cloth on time exposure.

The following equation illustrates the formation of the dyestuff—



Azobenzene chloride. Beta-naphthol. Red dye.

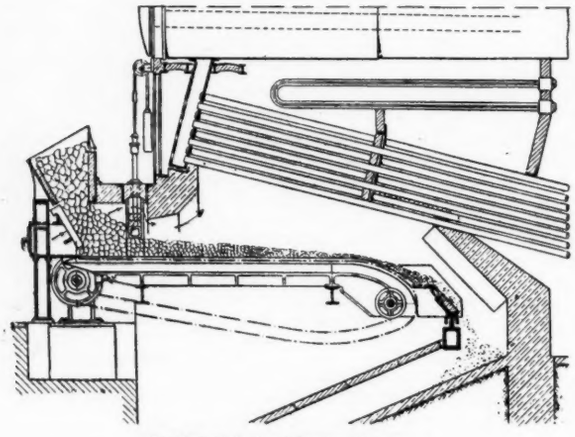
Naphthalene Derivatives.

If naphthalene is treated with concentrated sulphuric acid, in the presence of a little mercury as catalyst, phthalic acid is formed, which is dehydrated and yields phthalic anhydride on distilling at a temperature of 300° C. This substance sublimes in beautiful, white, needle-like crystals, and on heating with a little phenol and concentrated sulphuric acid phenol phthalein is produced, which is well known in the laboratory as an indicator; yielding a purple colour in alkaline and a colourless one in acid solution. If the anhydride is heated with resorcinal (di-hydroxy-benzene), fluorescein is formed—a dye which gives a fluorescence in water, with reflected light. Fluorescein itself is not a good dye-stuff; but its halogen derivatives—such as the bromide and the iodide—are of considerable value.

COKE AS A BOILER FUEL IN GERMANY.

The "Electrical Review" last week, Dec. 31, had an interesting article on this subject—pointing out that, owing to the shortage of labour (probably as much potential as actual), and the closing of various foreign markets, energetic measures have been taken in Germany to prevent the possibility of a serious coal famine, and to utilize coke which would normally be exported. These measures have attained a considerable degree of success; and from various reports it appears that a number of German electricity supply stations are using coke for boiler-firing.

Where a mixture of coal and coke is used, no particular trouble is experienced, beyond that of obtaining and stoking a reasonably uniform mixture of the two fuels; but the use of coke alone is a less simple matter—particularly if machine stokers be employed. It is impracticable to break and grade coke so that it can be used satisfactorily in sprinkler stokers; while if it be attempted to use coke alone on a travelling grate, the difficulty is to ignite the gas-free fuel as it enters the combustion chamber. Normally, heat from an incandescent arch of refractory material over the point of entry of the fuel, frees gases from the latter; and these gases burning with a long flame keep the arch hot, and thus render the whole action of ignition continuous, once it is started. With a fuel like coke, free from volatile gases, this action fails, and the fuel ignites late and imperfectly, if at all, as the grate advances.



Section of Coke-Burning Furnace.

An ingenious method by which this difficulty has been overcome is shown in the accompanying illustration [from "Zeitschrift der Verein Deutscher Ingenieure"]. The lower part of the coke-feed hopper is lined with refractory bricks, and fitted with an inclined grate at the front, and a flue at the back leading into the combustion chamber of the boiler. There is thus formed a hopper furnace, which preheats the fuel above it, and brings it to incandescence before passing it on to the travelling grate. The greater part of the heat which is not usefully employed in this direction passes beneath the boiler, and is there utilized. This equipment, which is due to Belani, of Essen, is said to have been tested with satisfactory results on a water-tube boiler in the Düsseldorf Elektrizitätswerke, though, owing to some mishap during the coal-firing tests, all that could be established was that the results with coke firing were more favourable.

Other tests—this time on a boiler with an ordinary horizontal grate—showed that coke may be literally a better fuel than coal of higher thermal value. The heating surface was 1680 square feet, and a flaming coal of 13,000 B.Th.U. calorific value raised 3·4 lbs. of steam per hour per square foot of heating surface, or 6 lbs. per pound of coal. On the other hand, coke of 12,600 B.Th.U. per pound (size ranging from dust to 2¾ inches) raised 3·8 lbs. per square foot of heating surface, or 6·6 lbs. per pound of coke. The highest measured combustion chamber temperature and the flue gas exit temperature were respectively 1220° and 376° C. with coal, and 1145° and 473° C. with coke.

The paradoxical superiority of the coke is due to its requiring a smaller surplus of air for combustion and suffering no loss from unconsumed gases or tar. On the other hand, it must be remembered that the preceding data evidently refer to anything but a modern high-power boiler; and no mention is made of the relative costs of coal and coke as boiler fuels. This is at present of minor importance to Germany as compared with the fact that her surplus coke supplies can be used—staving off the possibility of a fuel famine, and permitting full military advantage to be taken of the bye-products of coke manufacture.

AMERICAN COMMERCIAL GAS ASSOCIATION.

Convention at Washington.

Judging from issues of our American contemporaries which are now coming to hand, the recent Washington convention (the eleventh annual gathering) of the National Commercial Gas Association of the United States was an all-round success. The President was Mr. H. B. M'Lean, of New York; and he delivered an address (in the presence of over 300 delegates) in the course of which he dealt with various matters of importance to the Association. The lines of work prosecuted were also indicated in the report of the Board of Directors. The following officers for 1916 were unanimously elected:

President.—Mr. Jansen Haines (Des Moines).
First Vice-President.—Mr. Arthur Hewitt (Toronto).
Second Vice-President—Mr. W. Griffin Gribbel (Philadelphia).
Third Vice-President.—Mr. W. W. Barnes (New York).
Treasurer.—Mr. Oscar H. Fogg (New York).
Secretary & Assistant Treasurer.—Mr. Louis Stotz (New York).
Directors.—Messrs. J. B. Myers (Philadelphia), S. T. Willston (Brooklyn), B. J. Kellum (Chicago), C. R. Stull (Kingston), T. M. Ambler (Brooklyn), C. A. Munro (Chicago), H. L. Schutt (Philadelphia), R. R. Young (Newark), C. E. Babcock (San Francisco), and C. L. Holman (St. Louis).

There was an excellent exhibition of gas appliances in connection with the convention; and on three days of the week during which the meeting was held, no morning session was arranged, so as to allow members ample opportunity to inspect the appliances on view. Not only was there plenty of business to be done, but a programme of entertainments was organized, for both members and lady visitors, which reflected the greatest credit on those who prepared it.

Here is a list of the reports and papers which were presented.

Directors [Report]	
Treasurer [Report]	Mr. W. J. Clark
Finance Committee [Report]	Mr. W. H. Pettes
Amendments to Constitution [Report]	Mr. W. J. Clark
Public Policy [Report]	Mr. E. N. Wrightington
Membership [Report]	Mr. T. M. Ambler
Company or Local Sections [Report]	Mr. W. W. Barnes
Manufacturers' Section [Report]	Mr. W. M. Crane
Address of the President	Mr. H. B. M'Lean
Nominating Committee [Report]	Mr. P. S. Young
Time and Place Committee [Report]	Mr. Arthur Hewitt
"Selling Gas Service"	Mr. George Williams
"The Principles of Merchandising as Applied to Gas Service	Mr. Joseph H. Appel
Publicity Committee [Report]	Mr. J. M. Brock
Advisory Committee to the President [Report]	Mr. O. H. Fogg
Standardization of Gas Appliance Specifications [Report]	Mr. O. H. Fogg
Advisory Committee on Exhibitions [Report]	Mr. B. J. Kellum
Reciprocal Relations with Other Associations [Report]	Mr. J. D. Shattuck
Illumination Committee [Report]	Mr. R. ff. Pierce
"Theory and Design of the Injector as Adapted to the Blast System of Gas Burning"	Mr. W. C. Buell, jun.
"Theory of Lighting"	Mr. C. O. Bond and Dr. Ives
"Fundamental Principles of Good Lighting"	Dr. P. G. Nutting
Educational Control [Report]	Dr. Lee Galloway
Salesman's Handbook [Report]	Mr. C. Edwin Bartlett
Accounting [Report]	Mr. A. P. Post
International Committee on Commercial Advancement [Report]	Mr. Arthur Hewitt
Domestic Fuel Appliances [Report]	Mr. L. F. Blyler
Development of Industrial Fuel [Report]	Mr. S. Tully Wilson
Central Development Bureau [Report]	Mr. R. C. Ware
Heating, Refrigerating, and Ventilation [Report]	Mr. Geo. S. Barrows
Differential Rates [Recommendations of Committee]	Mr. P. S. Young

The selection of the place of next meeting was left to the officers, though New York City was tentatively decided upon.

CAST-IRON PIPE-JOINTS.

Preliminary Report of the Committee of the American Gas Institute.

In a "foreword" to their report as published in the "American Gas Institute News," the "Committee on Cast-Iron Pipe-Joints" say they wish it to be expressly understood that no portion of it is necessarily final. The object in allowing the publication of the report in this form is to endeavour to secure the most extended criticism, the necessity for which is made clear in the body of the report. The members of the Committee state that they are not in entire agreement upon all the suggestions made in the report.

Introduction.

The fact that cast iron has an indefinite life underground, under normal conditions, has led to its use for carrying gas and water. The disadvantages of cast iron for gas-work have been its fragility and the difficulty in making positive joints. It may be expected, however, that cast iron will continue to be used until an alloy of steel is developed which will give a certain life equal to cast iron at no increased cost.

The subject of proper joints to use for cast iron has been the cause of a great deal of experiment, the data of which have never been presented. It has also been discussed frequently in technical sessions and in papers without any definite conclusions. At present, engineers are using various kinds of joints, largely depending on their own opinion or the opinions of their subordinates. It was on the belief that it would be possible to standardize practice, that the Committee was appointed.

Theory of the Joint.

For many years pipe-joints were made of lead backed with some form of packing, usually tarred or untarred jute. The lead was cast in place and subsequently caulked. About twenty-five years ago the cement joint was introduced, and came into use extensively; but as far as the Committee have been able to learn there was no scientific theoretical reason for adopting this joint. It was tried, found satisfactory and durable, and gradually came into more frequent use, until at the present time it is being used for small mains under normal conditions by practically every gas company in the country.

The use of cement joints was extended to larger mains with apparent satisfaction. Later developments, however, have brought up strongly the question of the advisability of cement joints for large main-joints. At the present time opinion is divided, as is discussed later in the report.

Cast-iron main-joints may be divided into two classes. First, the rigid joint, in which no possible movement could take place at the joint without leakage. Second, the flexible joint, in which slight movements may take place without leakage. To the first of these classes belong the cement joint, welded joint, bolted flange joint, and the one or more forms of special bolted iron-to-iron joints. To the second belong lead joints, lead-wool joints, combination lead and cement joints, joints with special impregnated packing, and all the various types of joints made-up of special clamps with elastic gaskets.

For a rigid joint to be successful, the change in temperature of the main underground should not exceed an amount which will produce stresses in the pipe greater than the strength of the joint. It is not difficult to arrive at changes in underground temperature due to seasonable changes in temperature, and from this calculation the probable stress set up in the pipe by such change. In the calculations made by the Committee, the modulus of elasticity for cast iron was taken at 15,000,000; the coefficient of expansion, 0·00000556; and the ultimate tensile strength of cast iron, 20,000.

A bar of cast iron rigidly held at both ends is stressed to its ultimate tensile strength by a change of temperature of about 240°. The underground changes in temperature may be expected never to exceed 50°. Therefore, it may be said that cast-iron pipe has a safety factor of approximately 5 under these conditions; and any joint which will be and remains more than 20 per cent. as strong as the pipe will be theoretically satisfactory.

There are no experimental data sufficiently elaborate to specifically give the strength per square inch by contact between the cement and iron in a cement joint; but even in the absence of experimental data, the Committee have sufficient data from practical experience to draw fairly safe conclusions.

Cement joints in small mains, 4-inch and 6-inch, have been in use in a number of locations throughout the country with entire satisfaction for over twenty years. This would seem to be sufficiently long to make certain their dependability for small mains. For large mains the cement joint has not proved entirely satisfactory. Theoretically, this is not unexpected. There seems to be no logical reason for making a rigid joint of a given strength and not increasing the strength when making the similar joint in large mains where it is quite obvious that the stresses will be increased. The point of the matter is that if satisfactory 4-inch cement joints in standard "A. G. I." bells are properly designed for strength, then, as the strength depends on the area of the bond between the cement and iron, it is obvious that no joint larger than the 4-inch is strong enough. Of course, there is no justification in assuming that 4 inches is the standard, or that it is too strong, and, therefore, the larger joints are strong enough. But as stated before, in this discussion the Committee have had the practical experience of a long life in 4-inch cement joints.

In all the other types of rigid joints, the large first cost has inhibited their extensive use. There is no reason to believe, however, that a rigid joint in a cast-iron main of any size would not be satisfactory; and if such a joint can be designed at practical cost, there would seem to be no reason for not adopting it.

The lead joint has been used for many years, and has usually resulted in small leakages at the joint sooner or later. Based on the fact that there is probably a very slight movement taking place at each joint, the Committee would expect this result to follow. The lead-wool joint is an advance in art, by the substitution of prepared lead wool for cast lead. It is advanced only in the fact that the complete compression of the lead ring can be assured, which, of course, is only true if the packing is compressed sufficiently hard to form a rigid backing for the lead. On this theory, the combination joint of packing cement and lead has come into use extensively within the last two years. The theory of this joint is that the rigid cement ring effectually maintains the alignment, and provides a solid backing against which to caulk the cement. It is not maintained by its advocates that this joint is rigid. It is thought that the same slight movements probably take place; but because of the method of making, which insures a more efficient joint, these movements will be so slight as to postpone leakage for an indefinite time.

There has not been sufficient time elapsed since these combination joints have been extensively used to determine whether they are going to be permanently satisfactory or not. The longest time in which combination joints are known to have been used is about nine years in large mains with entire satisfaction. These were combination cast lead and cement joints in a 20-inch line.

Another type of flexible joint consists of a packing impregnated with some material insoluble in gas; the joint being packed solidly with this material, leaving room in front for a ring of lead or cement to act as a gland. The theory of this joint is that the packing acts as the packing in a stuffing-box, allowing the slight movements to take place, but remaining permanently tight. This theory seems to be sound; but it must be borne in mind that the packing is not placed between machined surfaces, but simply between the rough castings. Further, it is well known that expansion joints which are carefully made of machined fittings, and carefully packed, leak at intervals, and must be taken up. It is not urged that this is a fair analogy, but there does seem to be some similarity. In this type of joint also sufficient time has not elapsed to prove them effective.

Of the various types of clamped joints on the market, a number have proved satisfactory in so far as the design of the clamp was concerned—the failures being confined to the rubber gasket which was used exclusively until the last two years. These rubber gaskets had proved satisfactory through long service for natural gas. They have failed in a large number of cases in comparatively short service with artificial gas. Whether the substitution of the soft core fabric gaskets will remedy the trouble cannot be predicted. Theoretically these joints will eventually leak for the same reason that one might expect any other so-called flexible type joint to leak. The elasticity of the material will probably disappear, or the jointing material will be abraded sufficiently to allow small leaks.

Current Practice.

When starting upon its work, the Committee were familiar in a general way with the current practice of joint-making; but, in order to ascertain as far as possible the practice of the representative plants in the country, a brief series of questions was sent to seventy of the larger companies. A copy of these questions is attached to this report. Several interesting conclusions have been drawn from the fifty-eight answers received. A brief summary expressed in percentages follows:

	Low Pressure up to 10-inch Water.		Medium Pressure, 10-inch Water up to 5 lbs. Gauge.
Use standard bell and spigot pipe	94	..	94
Use extra depth of bell	6	..	6
Cement joints in small mains	62	..	53
Cast-lead joints in small mains	29	..	30
Lead-wool joints in small mains	9	..	17
Cement joints in large mains	29	..	25
Cast-lead joints in large mains	49	..	45
Lead-wool joints in large mains	15	..	19
Combination cement and lead	7	..	11
Size where line drawn between large and small mains, average (inches)	11·5	..	10·8
Small joints satisfactory—per cent. of total	98	..	97
Small lead joints unsatisfactory—per cent. of used	12	..	15
Small cement joints unsatisfactory—per cent. of used	0	..	0
Large joints satisfactory—per cent. of total	73	..	72
Large cement joints unsatisfactory—per cent. of used	53	..	67
Large lead joints unsatisfactory—per cent. of used	10	..	19
Large lead-wool joints unsatisfactory—per cent. of used	0	..	14
Large combination joints unsatisfactory—per cent. of used	0	..	0
Companies having tried some special form of pipe	29	..	*
Special joints satisfactory	35	..	0
Special joints unsatisfactory	65	..	0

* Not enough reported to give statistics.

Of the companies reporting, 65 per cent. used cast iron for medium pressure. Only 7 per cent. used cast iron for high pressure, or not enough to present data until further development by correspondence or investigation, for which there has not been time.

Care should be taken in drawing any final conclusions from the summary; but the Committee believe that there are certain strong tendencies in current practice which are clearly shown, and which may be taken to indicate in a general way what the distribution engineers of the larger companies are doing.

A table of this kind prepared (say) three years ago would not have shown any combination joints being used. The fact that there are no reports of failures of the combination joints is significant, but should not be taken as conclusive as yet, as sufficient time has not elapsed to determine their ultimate value.

The high percentage of large cement joints reported unsatisfactory is also significant. This does not mean, of course, that there was this percentage of failures. In fact, there is nothing in the reports to indicate any total failures. The conditions are probably that the cement joints in large mains are not satisfactory to the responsible engineers, and a strong effort is being made to improve the joints or substitute a more satisfactory type.

It will be noted that not by any means all the companies are using cement joints in small mains. The reasons for using lead wool in some locations are known to the Committee; but why any engineers are still using cast lead in small main joints under normal conditions is interesting, and should be developed further by correspondence.

A study of the summary indicates, however, that the large majority of engineers are thoroughly satisfied with the cement joint for small mains; and the Committee do not hesitate to recommend the cement joint in standard "A.G.I." bells for small mains, but do not feel that there are sufficient data at hand at this time to specifically set the limit of size over which the cement joints in standard bells would not be satisfactory. There has been prepared, therefore, a specification for cement joints, which embodies what the Committee believe to be the best practice.

Specifications for Cement Joints.

1. The efficiency of a cement joint depends on filling the clean joint with the maximum quantity of the proper quality of cement properly mixed.

2. In the "A.G.I." standard depth bells cement joints should only be made up to and including 8-inch mains.

3. In 10-inch and over cement joints should preferably be made in deeper bells, the depth of which should be not less than that given in the following tables:

Inches.				Inches.
10 to 5	..	..	..	20 to 6½
12 ,, 5½	..	..	..	24 ,, 7½
16 ,, 6½	..	..	..	30 ,, 8½

4. Mains of 4, 6, 8, and 10 inches may be laid on the ditch bottom; 12-inch and over on blocking.

5. The spigots and bells must be clean and free from all loose material. Dirt and scale must be removed with wire brushes and scrapers. Tar or any substance of an oily nature may be removed with gasoline, but must be subsequently scrubbed with soap and water and rinsed thoroughly with clean water. Clean bare iron is absolutely necessary.

6. The ditch must be levelled to a true bottom, and the bell-holes dug. The pipe must be entered, pushed home, and lined-up without entering any packing whatever in the joint—thus departing from the old practice, in small mains, of using the back-packing to lift and enter the spigot into the bell, and then driving-up the back-packing to space the joint. With a properly bottomed ditch, the joints will be very nearly spaced when the pipes are entered and lined-up.

7. In 4-inch, 6-inch, 8-inch, and 10-inch mains the joints must be spaced with wedges—see A, fig. 1.

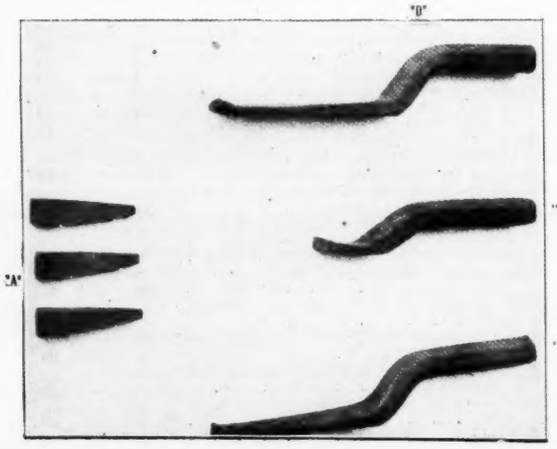


Fig. 1.—Caulking Tools and Wedges.

8. Tap in lightly two of the wedges at about the two lower thirds of the circumference of the pipe, and the third wedge at the top. Sliding the fore-fingers around the joint is a simple and accurate method of determining if the joint is properly spaced. Sufficient wedges should be provided to allow laying as many pipes as desired before joint-making.

9. Cover and tamp the pipe firmly into place between the bell-holes. The tamped earth covering has two important functions: (1) It holds the pipe firmly in place for the joint-making; (2) It maintains the pipe at a much more uniform temperature during the progress of joint-making and subsequently than would be possible if exposed to the atmosphere.

10. Use untarred jute packing, dry and free from oil in the bales.

11. The back-packing must be wet with clean water, and thoroughly wrung-out by twisting into a tight rope. The wet rope of packing must have a uniform diameter of from $\frac{7}{16}$ inch to $\frac{1}{2}$ inch. Do not grout the packing. The rope of packing should be of such length as to reach once around the spigot and lap 1 inch.

12. Remove the wedges and enter the packing. If the spigot has a bead, use the yarning iron shown at B, fig. 1, driving the yarn into the wedge-shape recess formed by the bead on the

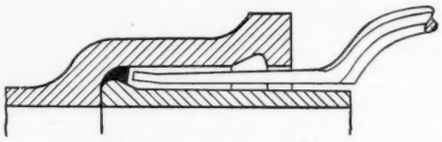


Fig. 2.—Packing Tool "B."

spigot and filet on the back of the bell, as shown in fig. 2. Use a 4 lb. caulking hammer for all cement joint work. If the spigot is cut, use the yarning iron shown at C, fig. 1, which will compress the yarn as shown in fig. 3.

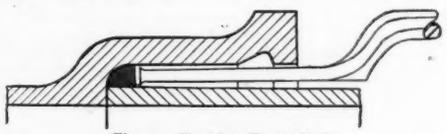


Fig. 3.—Packing Tool "C."

13. The cement should be a high-class medium setting American portland cement, must be in perfect condition, and must all be passed through a No. 50 screen before mixing. Mix thoroughly by hand to a consistency of a stiff putty in such quantity that all will be used within 15 minutes after mixing. Discard any mixed longer than this time. Mix in the shade.

14. With a small trowel fill the joint with cement flush with the face, then use a $\frac{1}{4}$-inch cotton rope slightly longer than the circumference of the pipe and drive in the cement with the caulking tool shown at D, fig. 1. Withdraw the rope and fill the joint flush with the face with cement. Wet and twist a piece of yarn that will be of uniform diameter of from $\frac{9}{16}$ inch to $\frac{5}{8}$ inch when twisted tightly. Drive this yarn into the bell with wide face caulking tool D.

15. The making of the joint must proceed continuously; there being no lapse of time between the successive operations.

16. Point the face of the joint with cement so that it is smooth and flush with the face of the bell. Fig. 4 shows a section of the finished joint.

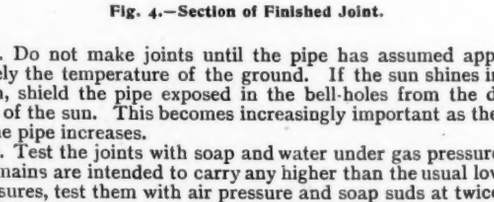


Fig. 4.—Section of Finished Joint.

17. Do not make joints until the pipe has assumed approximately the temperature of the ground. If the sun shines in the ditch, shield the pipe exposed in the bell-holes from the direct rays of the sun. This becomes increasingly important as the size of the pipe increases.

18. Test the joints with soap and water under gas pressure. If the mains are intended to carry any higher than the usual low gas pressures, test them with air pressure and soap suds at twice the pressure that the system is laid to carry. When testing with air at high pressures the test should not be applied until the joints have been made 24 hours or longer; and the greatest care must be used to avoid temperature changes in the pipe while waiting for the test.

19. The above method should be followed in the 4-inch, 6-inch, 8-inch, and 10-inch mains. For mains 12 inches and over (mains 10 inches and over must have special depth bells for cement joints), the same procedure as for mains 10 inches and under should be followed, with the following exceptions and additions.

20. After bottoming the ditch to a true line, wood blocks are set in front of and behind each bell, and carefully and solidly em-

bedded so that the top surface is the true plane of the bottom of the pipe. After laying the pipe and entering, the joints are spaced by wooden wedges on the blocking.

21. With bells 6 inches and over in depth, after driving the cement in with the cotton rope and withdrawing the rope, the joint must again be filled with cement and again driven in with the rope; then filled again with cement, and the front packing entered.

22. For mains 20 inches and over, the rope of back-packing must be from $\frac{9}{16}$ inch to $\frac{5}{8}$ inch in diameter, and the front-packing from $\frac{3}{4}$ inch to $\frac{7}{8}$ inch in diameter.

23. Increasing care must be used to maintain uniform temperature of the pipe as the size increases. Especial precautions must be taken to assure that there is practically no difference in temperatures between the top and bottom of the large pipe.

Comments on Specifications.

This specification has already been submitted to a number of distribution engineers; and the Committee have incorporated the criticisms that have been received. Also where the specification departs from current practice the reasons for the practice selected will be given.

[The numbers refer to the paragraphs of the specifications.]

1. This is based on the assumption that the cement joint is a rigid joint, and that its strength depends on securing most intimate contact between the cement and iron of the bell and spigot and filling the lead ring with cement. If the cement joint is not a rigid joint (which is incredible), then the amount of cement would still be an important factor, because it is obvious that the larger the area of contact the less likelihood there would be that the leakage would be serious under low pressures.

2 and 3. The Committee have purposely not made these paragraphs imperative because of the fact that in a few instances cement joints in large mains, as large as 20-inch and over, have been satisfactory in standard bells. There is, therefore, no justification for condemning the practice; but in face of the evidence of the dissatisfaction that has been reported, the Committee do not feel justified in recommending that the cement joint be made in the large mains in standard bells.

4. The large majority of engineers do not use blocking when laying mains in undisturbed ground. Either small mains are laid directly on the ditch bottom, or, where abnormal conditions exist, a special design is made. For mains 12 inches and over the blocking is used for joint-spacing as described under paragraph 18. The following schedule of blocking and wedges is suggested:

Size of Mains. Inches.	Size of Blocking. Thickness. In.	Width. In.	Length. In.	Size Distance Pieces. Thickness. In.	Width. In.	Length. In.	Size of Wedges. Thickness. In.	Width. In.	Length. In.
12	3	12	18	1	12	12	2	5	8
16–20	3	12	24	1	12	24	3	5	12
24–30	4	12	30	1	12	24	3	5	12

5. It would be possible to elaborate this paragraph, but the Committee believe it is sufficiently complete, particularly with the final sentence—that clean bare iron is absolutely necessary.

6. This is the first radical departure from the current practice, and was purposely adopted because the fundamental idea of this specification is expressed in the first paragraph; and in order to insure having the maximum quantity of cement in the joint, it is necessary to insure having the minimum quantity of packing required to insure a satisfactory joint. With the current practice of lifting the spigot by the back-packing, there is certainly a tendency toward having this packing unnecessarily thick and often unnecessarily long.

7 and 8. The carrying of the spigot on wedges tapped into the joint is not a new idea—having been used heretofore in making large main joints by a number of engineers. It is introduced here for the reasons given under 6. The additional labour adds very little to the cost of the joints. This was determined by actual experiment. It is one of the points selected by the Committee to insure better joint-making. A number of comments have been made on it, to the general effect that the operator has not found the practice necessary. This is not denied by the Committee; but the use of the wedges in small mains has been the practice in several locations, and has undoubtedly proved advantageous, and will certainly be an improvement, where the joints are undertaken by more or less inexperienced operators.

9. This paragraph is self-explanatory, but a brief discussion may be made here in regard to the effect of temperatures in laying mains with cement joints. Small mains have been laid with cement joints, when the atmosphere was below freezing point, with entire satisfaction. It is obviously necessary under these conditions to take additional protective measures; but the Committee feel that this is a matter of common sense and judgment on the part of the operator, and needs no specific recommendation in discussing the subject of cement joint making.

10. In ordering jute packing, the specification should state, "Dry and free from oil." But as a matter of fact, jute packing supplied by the trade will never be entirely free from oil or tar. A very small amount is not detrimental.

11. Here is a second departure from current practice, as the majority of engineers do not wet the packing. It has been found by experiment that wetting the packing has several advantages. In twisting it into a rope, it can be made tighter, and is comparatively free from projecting strings. In other words, it makes a smooth tight rope, as compared with a loose fuzzy rope when dry packing is used. It will pack more solidly into the bell, and when finished will have a more uniform front surface than dry packing. This was determined by actually driving the back-packing into split bells, which were subsequently taken apart and examined. It is also highly probable that a very dry packing does actually inhibit the setting of the cement in immediate contact with it. This was also tried in a split bell; and the cement in contact with dry packing, after one week's setting, was (while hard) more crumbly and friable than where the wet packing was used.

12. The question as to whether special tools are necessary for cement joints has been commented upon by all who have criticized the specification. One comment suggested that the design of tools offered would probably break in practice. This is simply a question of properly making the tools. Most of the other comments were to the effect that they had not found such tools necessary; and exactly the same reply is made by the Committee as in the discussion of paragraph 8. The tools suggested will give a more uniform ring of packing than will the usual type of yarning irons. This was proved by actual experiment before the tools were adopted for the specification. One comment on the specification suggested that the Committee recommend that cement joints should not be used where the bead is cut off the spigot. In the absence of any specific data as to the strength of the bond between the iron and cement, and, further, there being no reported experience from practice that these joints would fail in use, the Committee do not feel justified in making such a recommendation. This is particularly true as they do not feel that they have at this time any substitute joint to offer.

13. The original specification called for Dykerhoff cement as a first preference. This brand is practically out of the market, and, further, it is questionable whether it is as good as when it was first used for cement joints about ten years ago. Further work of the Committee should include the preparation of a specification for cement for cement joints. It will be noted that the cement must be in perfect condition, which was thought to be sufficient qualification, rather than to go into details; but the screening is included. This was done purposely, as even when cement is apparently carefully stored, it will sometimes become in spots a little damp and lumpy. The specification, therefore, provides for screening, to insure its being free from such lumps. It is provided that it will all be used within fifteen minutes after mixing; and this was specified rather than saying, "Mix enough for some given number of joints," which is the usual formula. The weakness of this is obvious.

14. The fact that a trowel was satisfactory to fill joints was determined by experiments with the split bells; but, of course, there is no implication that the cement may not be satisfactorily placed in the joint with rubber gloves, as is the practice in a number of locations. The trowel was cheaper and more durable. The use of the rope for driving in the first filling of cement is also not a new idea, but is offered in this specification as an improvement over the current practice. Experiments show that the width of the cement band would be increased $\frac{1}{2}$ inch by the use of the rope and the refilling, over the usual practice of filling the joint once either with gloves or with the trowel. If a pusher were used, there was not so much gain by the use of the rope. This is, however, one of the points that the Committee believe will go further to insure more uniform joint-making. If the practice as suggested is followed, there would apparently be no question of having the joint filled properly with cement, while the Committee do not believe this would always hold with the usual method of making the joints.

15. This paragraph is self-explanatory.

16. This pointing is done to seal the front yarn, and to make a sharp surface to test the joint. The operation can be done better with the trowel than with gloves. The section shown is an average of a number of joints made in the split bells by the methods described. There would seem to be no question that they are an improvement over the sections usually shown.

17. This paragraph was added as the Committee believe the efficiency of the operation will be increased if an approximately uniform temperature is maintained from the time the joint-making starts until the pipe is finally covered.

18. This paragraph is included because the majority of engineers believe that joints should be tested. As a matter of fact, a very respectable minority do not test their joints in small mains when laid for ordinary gas pressures.

19. This and the following paragraph do not imply that the Committee specifically recommend the use of cement joints for large mains. It is believed, however, that there is sufficient evidence to indicate that they can be satisfactorily made in deeper bells; and this and the following paragraphs are, therefore, included. Three reports on the use of deeper bells for cement joints for large mains have been received. One was used in combination with lead joints—*i.e.*, several cement joints followed by one lead; and the report was that the cement joints were entirely satisfactory. The second part was on a continuous line of cement joints. The report here was promising but not entirely favourable. The third was from a situation where cement joints in standard bells had been used in all sizes of large mains up to 24-inch with numerous failures. The experimental line had at the time of the report been in use for two years with no sign of failure. This was a line of main with depth of bell as given in

this specification and cement joints made up according to the directions.

20. It is not good practice to attempt to space large joints with the yarn when the minimum quantity of yarn is to be used as in cement joints. Therefore, the larger and heavier pipes are spaced with wooden wedges on wooden blocks.

21. This is added as an additional precaution to insure the complete filling of the joint with cement.

22. This is to care for the wider angular ring in the larger joints.

23. This is added as an additional precaution in caring for temperature changes.

Before leaving the subject of cement joints, one important advantage should be touched on, and that is a line of main laid with cement joints is practically a non-conductor. Data collected from electrolytic surveys indicate a large immunity in gas-pipe systems laid with cement joints.

The further work of any Committee on this subject should include experimental work to determine an efficient and reliable large joint. There has been a great deal of experimental work done, with some interesting results which are not as yet conclusive. Through the courtesy of the United Gas Improvement Company, a summary of the data of a series of tests made by Mr. O. B. Evans is given herewith.

The joints were made with 20-inch special bells and tested in a testing machine of 500,000 lbs. capacity at the University of Pennsylvania, and were subjected to alternate compression and tension. The tests were based on the fact that a 20-inch cast-iron main underground subjected to a temperature change of 30° would be stressed 125,000 lbs. and would be subjected to alternate compression and tension due to the seasonable changes. In these tests the joints were made up as carefully as possible; the bells being of the standard "A. G. I." depth. During the alternate compression and tension stresses placed on the joint, air pressure of from 2½ to 4 lbs. was kept on the joints; and they were tested for leaks by using a trough made of putty around the joint and the trough filled with water. This was a more positive method of testing than with soap suds.

The cement joint, which was made in the usual way, and not according to the Committee's specification (as this work was undertaken before the final specification was prepared), failed under a tension strength of 40,000 lbs.—approximately one-third the safe load. The cast-iron joint made with the standard method with yarn and cast lead properly caulked failed after six reversals at about 25,000 lbs. Lead-wool joints with 1 inch, 1¼ inches, and 1¾ inches of lead wool caulked with a pneumatic hammer in the usual way remained tight for fifty reversals with a maximum of 80,000 lbs. tension and compression with a movement greater than would be experienced by the main underground.

The combination cement and lead-wool joint, consisting of back yarn, a band of cement which was allowed to set, and then lead wool caulked in front proved about the same efficiency as the lead wool and yarn alone.

These experiments were continued with cement, cast lead, lead wool, and combination lead wool and cement, with the results that the lead wool or combination cement and lead wool, caulked with a pneumatic hammer, was shown to be the most satisfactory under laboratory conditions.

At this time the Committee feel justified in suggesting that in mains 10 inches and over a joint made of a combination of cement and lead wool will probably prove satisfactory. An inch of lead wool gives as high an efficiency as the wider bands in making up these joints. After filling the joint with cement to a point 1¼ inches from the face of the bell, the space should be carefully cleaned; and after the cement has set not less than 24 hours, the lead wool should be caulked-in with a pneumatic hammer or with hand caulking tools and 8-lb. striking hammers.

The further work of the Pipe Joint Committee should include the proposition of preparing a definite specification for the making of these combination joints. Unfortunately, the United Gas Improvement Company's experiments have not as yet taken up the cement joint in deep bells. It is hoped that this work can be done within the next year.

One further interesting experiment which Mr. Evans made was on a joint with impregnated yarn. This joint is made up on the theory of the stuffing-box as described earlier in the report. Under the test the joint failed under eighteen reversals at 40,000 lbs. pressure with an elongation of 0·2 inch. This method of testing was not conclusive, however, because 0·2 inch is a much greater amount than a joint would move with the underground range of temperature. The Committee believe that the only laboratory test that would give any indication of the value of this joint would be to subject the joint to continuous reversals through a range slightly in excess of that which would be expected in underground work.

In line with the so-called stuffing-box joint, and on the theory that the packing plays a most important part in any type of so-called flexible joint as distinguished from the rigid joint, Mr. Evans made a very interesting experiment. He found that, with two joints made up as nearly as possible identical, the one with the yarn driven the harder showed the lesser tendency to leak. If this could be shown by laboratory experiment to hold in practice, it would make a most interesting advance in the practice of joint making. The idea is, the Committee consider, worthy of much further experiment.

DISTILLATION OF TAR ON GAS-WORKS.

[From a Correspondent.]

In the December issue of "Het Gas," Heer A. P. Bruigon publishes some reflections concerning the treatment of tar in gas-works plant.

The author points out that all sorts of gas-works residuals are treated in gas-works plant, sometimes in fairly intricate installations, and that many of these treated residuals represent marketable products which are easily sold, and yield in most cases a good profit. Tar in this connection occupies an exceptional position, as there are only a small number of gas-works where it is distilled. He inquires as to the cause of this. The treatment of ammoniacal liquor for the production of sulphate of ammonia and the extraction of cyanogen and sulphur products from the crude gas or from spent oxide has never been a philanthropic matter, nor is it so with the distillation of tar in chemical works. Tar has not followed the general progress in technical operations. Everywhere else one meets with modernization of appliances and of the plants in use; but in the matter of tar, time had gone on and left the stills in the same primitive state as they were when chemists started the distillation of it. In many cases, tar is distilled in the same manner as it was fifty years ago, in stills of sheet iron—the capacity varying between 5 and 30 metric tons. The residue left in the stills is the pitch; and before the still can be filled again, this must be removed. There is thus no question about a continuous operation.

The principal improvement of recent years is confined to the substitution of indirect heating by means of hot water or steam for direct heating. But with these modes of heating it has proved very difficult to obtain the necessary temperatures; so that there followed the use of a vacuum, so as to reduce the boiling-points of the components. In this manner, the working of the plants became less economical; and so the processes are to be regarded as things which have led the tar chemists astray. The laws of physical chemistry tell us that in the tar distillation process all the components are volatilized simultaneously, but in such a manner that of the components with lower boiling-point there is a larger quantity present than of the higher boiling-point constituents. Thus the condensed distillates are far from homogeneous, but contain, on the contrary, both higher and lower boiling products. Continuous boiling for a long time of a voluminous mass requires a considerable amount of heat; and as the viscous liquor has a tendency to boil over, and tar possesses great inflammability at these temperatures, the fire danger is real. Furthermore, the stills have only a short life. These are features of old-time tar distillation; and it is somewhat peculiar that only recently have methods been devised for the treatment of tar in a different manner. Among these modern methods, the Kubierschky continuous process may be mentioned; but, of course, there are others that would be suitable.

Kubierschky does away with all the old plant, with its fire-danger and high cost of wear and tear, and uses a column apparatus, similar in appearance to an ammonia still used for sulphate making. The crude tar is pre-heated, and flows continuously in a thin jet into the apparatus, where it passes downwards along coke or other suitable filling material, while a jet of superheated steam is introduced in an upward direction. The presence of steam of a relatively low temperature with regard to the boiling temperatures of the heavy oils, causes the vaporization of the lighter oils as well as of the heavy oils; but the composition of the vapours is governed by the law regulating the vapour pressure of heterogeneous liquids at a given temperature. When distilling at 100° C., and under atmospheric pressure, oils that have a boiling-point of 200°, 300°, and 400° C., the quantities of steam needed for the distillation of equal quantities of these oils are in the proportions of 1 : 8 : 60; but working with superheated steam of 200° C., these proportions become 1 : 1·6 : 2·4. Better than words, these figures demonstrate the highly favourable influence of the use of superheated steam.

The distillation is carried out by degrees, and in such a manner that the vapours are immediately separated from the remaining liquor. In the bottom part of the apparatus, no vapours of low boiling-point are present; so that the hot liquor leaving the column is nothing more than molten pitch, which becomes perfectly solid after cooling. Of course, the distillation may be so conducted that soft pitch is obtained, and the separation of the fractions is sufficient for gas-works purposes. The consumption of steam is about 30 lbs. per 100 lbs. of tar; being equivalent to about 4 lbs. of coal. The starting of the plant may follow directly after the apparatus has been pre-heated. The tar inlet and steam inlet are regulated by valves, so that from this point of view no special cost is incurred. Insurance and depreciation are reduced with this dangerless system. The only auxiliary plant needed for the working of it is a steam-generating plant; and this is to be found on gas-works of any size.

The author gives some figures regarding a plant for a gas-works producing 1500 metric tons of crude tar per annum, and where therefore the gas production in the same period would amount to about 350 million cubic feet. For this plant, a building 13 ft. by 17 ft., and 20 or 23 ft. high is necessary. The 1500 tons of crude tar will give 600 tons of tar oil and 900 tons of hard pitch. Taking the selling price of crude tar at 35s. per metric ton, and that of pitch at 45s., the return for the tar oil produced is calcu-

lated at 30s. 5d. per metric ton. This figure is arrived at in the following manner:—

Installation cost (stills, pipes, tank, pumps, building, and fitting up)	£750	0	0
Working cost (interest 5 per cent., depreciation 10 per cent., repairs 2 per cent.)	217	10	0
Tar, 1500 tons at £1 15s.	2625	0	0
Steam	45	0	0
Fuel oil	52	10	0
Wages	50	0	0
Water and light	10	0	0
Insurance and unaccounted-for costs	30	0	0
	£2940	0	0
Revenue from 900 tons of pitch at 45s.	2025	0	0
Cost price of 600 tons of tar oil	£915	0	0

Taking the selling price of tar oil at £2 12s. 2d. per ton—a low price—the net profit of the undertaking is reckoned at about £650, which is a good figure, in view of the capital cost of the plant.

The author also gives some figures supposing that the tar oil is not sold in the market, but is used on the works for the carburetting of water gas. In this case, we will not follow the author in his calculations; for we all know, from practical data, that tar oil is not a carburetting material which gives very tempting results in carburetted water-gas apparatus. It is certainly of interest that the gas industry have at their disposal new working methods for dealing with a residual of high intrinsic value. In many instances, the market value of this residual has been governed by several outside factors—such as freight and storage; but the new system will change this, and enable gas-works to derive the full profits of the residuals they produce.

EFFECTS OF ELECTROLYSIS ON PIPES.

Gas and Water Tracks and Electrical Drainage.

Dealing with the effects of electrolysis on engineering structures, the case of underground piping was naturally considered at some length by Mr. A. F. Ganz (Professor of Electrical Engineering at the Stevens Institute of Technology), in an address which he delivered before the last International Engineering Congress, held in San Francisco.

Referring specially to gas-pipes, he said it is sometimes found that underground pipes and other metallic structures of a gas-works receive stray currents from the various pipes which connect the works to outside piping systems. Since stray currents are particularly objectionable here, on account of electrolysis and also possible danger from electric sparks, the entrance of such currents has, in some cases, been prevented by installing insulating joints in each of the pipes connecting to the works. In one gas-works, which is located on a salt-water inlet opposite the railway power station, large stray currents were found flowing through, and endangering, not only the piping of the works, but also the bottoms of tanks. At the railway power station, the negative bus-bar was connected by bare underground cables to tracks directly in front of the station; and this caused to concentrate towards the power station stray currents, some of which, in their path, flowed through the gas-works. In the case of two oil-tanks, stray currents of considerable magnitude were found to flow to them from the connecting oil-pipes, and thence to earth. To protect the tanks, insulating joints were installed in the pipes, thereby preventing the entrance of current. The stray currents through the works were later sufficiently eliminated by disconnecting the bus-bar at the power station from the tracks and from all ground contacts, and installing insulated return feeders to points in the tracks surrounding the gas-works, which feeders were proportioned for equal voltage drops. In this way, a substantially equipotential zone was set up around the works; and the former tendency for current to flow through them was in this way removed.

While in a number of American cities electrical drainage has, proceeded Professor Ganz, been applied to both the gas and water piping systems as a protection against electrolysis, no complete tests of an extensive electrical drainage system applied to pipes are available, so far as he is aware. Such tests as have been published consist only of current measurements on the pipes and of potential measurements between the drained pipes and trolley tracks. The complete data from which to judge the effectiveness of the system would involve the results of many other tests, particularly of measurements of drop-across joints in the pipes, and of measurements of potential difference between the drained pipes and other underground structures.

Electrical drainage was first applied to lead cable sheaths; and the success in protecting cable sheaths in this manner led to the attempts to apply the drainage method also to pipes. There are marked differences, however, between an underground piping system and a lead cable system, which render the piping system much less suited for electrical drainage. The principal difference is that cable sheaths are continuous electrical conductors; while pipes may be more or less discontinuous—due to the presence of high-resistance joints. Another difference is that the lead cable sheaths are relatively small, and are carried in ducts, which are mostly non-metallic. Thus only part of the surface of the cables is in contact with earth; whereas underground pipes are buried directly in earth, and generally present enormous contact areas to earth. The consequence is that when electrical drainage is applied to pipes, the currents on the pipes are very greatly increased. This results in danger of current shunting around high-resistance joints or leaving the pipe on the positive side of a joint to flow to other structures.

If the pipe which is electrically drained is one which conveys an inflammable liquid or gas, or if it passes through a manhole or other confined space where inflammable gases may collect, the flow of stray current on the pipe may involve the danger of an explosion or fire, particularly at times when the continuity of the pipe is interrupted for repairs or from other causes. Many cases have been reported where, in interrupting or rejoining or re-caulking mains, electric arcing was produced. Professor Ganz has found that in a number of cities where pipe drainage is employed it is the general practice, when mains are to be interrupted or a joint is to be re-caulked, to first connect a heavy copper wire across the proposed break, so as to prevent danger from arcing. He has also come across one case where a high-pressure gas-main pulled apart at a joint in an open ditch, and the arc caused by the interruption of the main ignited the gas, and made it necessary to shut off the gas from the main, and therefore the gas supply for an entire town, in order to extinguish the flames and repair the break. In this case, the gas-main was electrically drained to the power station, and carried a large current.

Where both gas and water service-pipes enter buildings, the result on the pipes of producing large stray currents is generally also to produce a flow of these stray currents through buildings; the current flowing in on one service-pipe, passing to the other service-pipe through metallic contacts in the building, and then flowing out on the other service-pipe. Such stray currents through buildings constitute a serious fire risk. The Professor has seen cases where severe arcing was produced between water and gas service-pipes in buildings whenever there was a vibration of the pipes. The complete application of electrical drainage to pipes will, he declares, involve draining all underground piping systems—and, in fact, bonding together all underground metallic structures affected by the stray currents—in such a way that at every point where different structures come into proximity in earth, they are brought to practically the same potential. If this is not done, there will be at such points a flow of current through the earth from the structure of higher potential to that of lower potential, thus causing corrosion of the former.

When electrical drainage is applied to a single system of underground pipes, without making a complete investigation of the effects of possible high resistance joints, &c., the installation may be made at relatively small cost; and, when so applied, it usually relieves the acute danger from electrolysis in the immediate neighbourhood of where the drainage connections are made. Both of these considerations have served to favour the electrical drainage system. However, a single drained underground piping system becomes a source of serious danger to other systems. If electrical drainage is applied comprehensively to all underground metallic systems, it will not only be found very expensive to instal, but likewise expensive to maintain, because as railway and piping systems are changed, the drainage system must be changed accordingly. The large increase in current on underground structures produced by electrically draining them, also brings about dangerous conditions at scattered and unknown places, which is a serious objection to this method. As an example, in Pittsburgh, where electrical drainage is extensively applied to the water and gas pipes, it is reported that by way of the drainage cables which connect to these pipes from the main railway supply station, the current drained from the pipes is nearly one-half of the total station current.

Concluding this portion of his address, Professor Ganz points out that in future installations of underground piping systems in the neighbourhood of electric railways, precautions should be taken to minimize the flow of stray current to the pipes. To this end, the pipes should be laid as far from the electric railway tracks as practicable. Metallic contacts with the tracks must be carefully avoided. Where the pipes cross steel bridges carrying electric railway tracks in metallic contact with the bridge structure, the pipes should be supported on wooden blocks or be otherwise insulated from the metal of the bridge. Insulating joints should be installed at the entrance of pipes to all car sheds, as it is frequently found that the pipes inside the sheds are in metallic contact with the tracks through the building structure. In special cases of individual pipe-lines, insulating joints, and, in some instances, also insulating covering of adequate thickness, may be employed in localized sections, where conditions are found to be suited to their installation.

Coke as Railway Fuel.—The scarcity of coal, which has prevailed in diverse quarters during the war, has caused more attention to be paid to other fuel—in the first instance coke. According to "Engineering," in Sweden coke has, to a considerable extent, been used for locomotive fuel mixed with coal; but recent experiences have shown that coke is better suited for this purpose during the summer than the winter—the reason being attributed to coke absorbing more moisture from the atmosphere in damp weather than is calculated. As a result, trains have frequently been late; and the State Railway Department recently ordered that only coal should be used during Christmas time, which always brings about much increased traffic.

DEFINING "DOMESTIC PURPOSES" IN WATER SUPPLY ACTS.

In the issue of the "JOURNAL" for Dec. 21 (pp. 645-647) there was given the text of the paper on the above subject read at a meeting of the Institution of Water Engineers by Messrs. A. B. E. BLACKBURN and PERCY GRIFFITH. It led to the following

DISCUSSION.

The PRESIDENT (Mr. F. W. M'Cullough, of Belfast) said they were much indebted to Mr. Blackburn and Mr. Griffith for their interesting paper on the important subject of the definition of the term "Domestic Purposes." He moved a vote of thanks to the authors.

Mr. H. ASHTON HILL (South Staffordshire Water-Works Company) seconded the motion, which was heartily carried.

Mr. ASHTON HILL, opening the discussion, said the authors asked "whether it was not time to reconsider the whole question of domestic charges on its merits, and devise some method, firstly, of limiting the application of the term "domestic purposes," and, secondly, of adjusting (if necessary) the rates of charge as between "domestic" and "non-domestic" uses. How were they to do this? Later on in the paper, it was suggested that it might be done by each undertaking putting in the next Bill it promoted in Parliament a provision as to what was wanted, or an amendment of the Model Clause might be made. It appeared to him that the direction in which they had to work was to consider first what was to be done. Then the authors said that the further questions of what quantity of water and what specific uses of water were to be regarded as essential to health, should be carefully considered and settled by sanitarians, just as, in the matter of defining the term "pure and wholesome water," a standard should be fixed by chemists and bacteriologists. The water engineer would then know what was required of him, and be able to definitely calculate his liabilities both in regard to quantity and quality. They well knew what difficulty the Sewage Commission had had in their various reports in trying to found a standard for sewage; and he thought they would have greater difficulty in finding and adopting a standard for water. As to the liability regarding quantity, when they began to talk about quantity, it meant meters. The disadvantage of metering domestic supplies universally in this country had been generally admitted; and it had been recognized that it was cheaper to waste some water than to go to the expense of universal metering. The authors also said the individual consumer must be made to pay his fair share. But he (Mr. Ashton Hill) thought the individual consumer did so at present. He looked upon the matter of paying for water as being more or less a tax. The poor man got a great deal of water for little pay; and the rich man probably did not get any more, but paid a good deal more. He did not think they, as water engineers, wanted to disturb this happy arrangement. Regarding supplies for trade purposes in factories and workshops, he had just been considering a case which was perhaps an illustration of what was spoken of by the authors. In the works in question, they had two supplies, which were now metered, but were not formerly, as it was held that the supplies were for domestic purposes—for drinking by the workmen. The water for manufacturing purposes was obtained from the canal. Now they had an application for the laying of a fire-main into the works; and a second application was for taking a service-pipe from the end of the fire-main for another drinking supply. The owners of the works questioned the Company's right to make the demands they were now doing. It was seldom the Company had anyone tackling them in this way. The Solicitor to the owners of the works saw him on the subject; and he (Mr. Ashton Hill) simply told him that what was wanted could not be done. He was tackled on the subject of the fire-main. There was the question of its maintenance in the roadway; and he got the works owners to take upon themselves the responsibilities in regard not only to maintenance, but to repairs. He pointed out that they could not open the ground in the roadway, while the Company could; and so he said: "We will do it at your cost." Then they wanted the service-pipe at the end of the main without a meter; and he settled the matter by telling them it was not possible. He thought that water authorities should set their faces against having metered and unmetered supplies on the same premises, because there were some people who, intentionally or unintentionally, would forget the different purposes, and would go to the unmetered supply largely in preference to the metered supply. Then the authors spoke about the needless multiplicity of lavatories and other sanitary conveniences. He did not know what they meant there, because it was only possible to use one lavatory or convenience at a time. There were different principles applied to the charging for water. One was to get as much revenue as one could, and give as little as possible for it; another way was to estimate fairly the probable quantity of water that would be used, and then, according to the scale of charges, give the quantity of water, and anything registered by the meter over and above must be paid for in addition. There was another system of charging with which he was familiar, but which he did not think obtained very generally. It was this: Suppose a dwelling-house with attached to it premises used for trade. The house was rated (say) at £100 a year, and, if the town was not an expensive one for water, 3 per cent. might be paid as the water-rate for the house. Then there were the uses in the factory, which might amount to £10 a quarter, or £40 a year. What they did was to first make sure of the income for domestic supply on the rateable value to which they were entitled; then, adding a sum for the trade purposes, they said: "We will allow you so much water for that sum, which is a minimum." His Company did not find the slightest difficulty in making such an arrangement. The authors suggested that any alteration in the law should certainly have in view not only the interests of the water authorities and their officials, but also those of the public, who suffered quite as much from the present condition of affairs. He (Mr. Ashton Hill) did not know that he was suffering from anything in particular in this regard; and he did not hope to. Referring to non-domestic water supplies that were beneficial to the community, the authors cited supplies to trades which might be attracted to a particular area because the charges for water were low. But there might be other reasons than low charges; for instance, the water in the area might be good for ale, as at Burton. The authors seemed very anxious on behalf of the consumers, and urged that charges for similar purposes should be uniform in any district, so as to avoid preferential treatment. There were some undertakings—particularly small ones—which could only live by supplying both gas and water, and which probably had one very large consumer, and as a matter of policy they had to have differential prices. It was also proposed in the paper that special charges should be scheduled to Private Acts, so that there could be no doubt as to the charges being authorized by Statute; and then, when it was desired to alter the charges or add new items to the list, it seemed to the authors that alterations might be made from time to time merely with the approval of the Local Government Board, without going to the expense of promoting a Private Bill. He did not believe that the Local Government Board would welcome this extra duty. The filling of gasholder and petroleum tanks was something out of the ordinary; and, under the proposal as to special charges, until they had been to the Local Government Board, and got such tanks added to the list, they would be making an illegal charge for filling such tanks.

Mr. C. B. NEWTON (Hull) said he was sure all the members agreed that the paper was a very clear statement of the position which had disturbed the minds of those engaged in the business of water supply. The trouble experienced by the Metropolitan Water Board appeared to him to centre in the fact that too little regard was paid to the variations in the "intensity" of water consumption between one class of property and another. The Act of 1907 imposed a flat-rate of 5 per cent. for domestic supply; and the only variation allowed was a rebate of 20 per cent. in cases where the premises were assessed in a sum exceeding £300 per annum; and then only when the premises were not charged with inhabited house duty. The charge for domestic use of water was 5 per cent. on a house in the suburbs rated at £50, and 5 per cent. on a suite of offices in the City rated at £1250. In the first case, the rate produced 50s. per annum; and in the second case, after allowing for the rebate, it amounted to £50 per annum. It was quite conceivable that the actual consumption of water might be identical in each case. There was clearly something wrong in this scheme of charges. The water undertaking must be provided with an income sufficient to meet all liabilities; but the burden should be more fairly distributed. Further, he thought that modern sanitary requirements and the improved conditions under which they now lived had entirely disposed of the old 5 per cent. water-rate on dwelling-houses. In these days a rate of 7 per cent. appeared quite reasonable; and many large undertakings had imposed 10 per cent. To charge a rate suitable for dwelling houses on the heavy assessments carried by lock-up premises in business thoroughfares was an imposition; and, as it was out of proportion to the quantity of water used, or the service rendered, it was wrong whichever way one took it. Most large cities and towns in the provinces did these things much better. It was the fashion just now to standardize everything. But were they sure that, if it were possible to standardize a definition of a "domestic use" of water, this in itself would remove all difficulties? Probably their troubles would only begin when this was done; and, judging from the paper on which their friends had bestowed so much labour, he rather thought their own phrase "a vista of further litigation" summed up the future prospects. He would submit that a key to the solution of this problem was to be found in section 12 of the Water-Works Clauses Act, 1863. Here they had certain uses of water—for cattle, for horses, for washing carriages, for trade, for watering gardens, and for other purposes—expressly excluded from domestic uses. Surely, it would be comparatively simple for each water authority to settle for its area the particular uses which should be regarded as suitable for exclusion, and specify each and every one in its Private Act. This should establish a negative definition as a harbour of refuge from these troublesome matters. As a practical method of dealing with the rather difficult case of the combined domestic and business supply, he advocated a more general application of the principle of affording such supplies by measure, but insisting, as referred to by Mr. Ashton Hill, on a minimum charge corresponding to the domestic rate. The excess consumption beyond the value of the domestic charge would then very probably come into the account as an extra. This, in his opinion, was a simple and safe method of dealing with the difficulty.

Mr. E. ANTONY LEES (Birmingham) said, in discussing this paper, the members must keep in view what the authors had in

mind, which was the searching out for some basis for a new arrangement which might be equitable from the points of view of the water undertaking, the consumer, and the public, rather than merely summing-up the position in which they found themselves in consequence of recent legal decisions. Exception seemed to be taken to the system followed in the Metropolitan Water Board Act of charging a uniform rate. Personally, he did not acknowledge the complete inequity of it. He thought that a uniform flat-rate, with proper allowances, was a right way to proceed. The respect in which he thought the Water Act fell short was that the allowances that were made in special circumstances were not altogether proper. Mr. Newton spoke of a house rented at such and such a sum in the suburbs, and another premises rented at a higher figure in the City—the one having to pay twelve or twenty times as much as the other. Mr. Newton seemed to think that this was in itself necessarily an inequity. If it was an inequity, they had many instances of it. There was rateable value fixed according to the position and importance of the premises. The people cost the authorities—for instance, for street cleansing—more than the house in the suburbs, although it might occupy more frontage. But it was felt that, in the interests of the public as a whole, there should be a uniform rate for street cleansing. Then, again, the premises in the City received protection against fire, and the risk was very much greater there than in the suburbs. But there was a saving on fire insurance by reason of the provision for water supply. These seemed to him to be reasons why highly-rated premises in the middle of the City should pay for their water supply—not merely for the water consumed, but for the provision of the public supply—at a flat-rate similar to that in less expensive areas. At the same time, he did recognize that there was a proper differentiation not on the ground of difference of rateable value, but difference of user. Here was a block of offices in a City which was only partially occupied. The ordinary residence was occupied the whole time; meals were cooked, and morning uses—ablutions, &c.—took place there. In the City it was only an occasional need during the day that called for the consumption of water. It seemed to be reasonable, then, that the question of partial user should come in, and should go to provide for a reduction in what one might term the flat-rate. Then came in another consideration—that the supplier of water wanted to be protected in respect that the partial occupation should not only theoretically but should actually entail a partial consumption of water. In Birmingham, they had recently secured a revised scale of charges. They obtained it after the decisions in the Avery and Oddenino cases; and they proceeded by intelligent anticipation by the method suggested by the authors of the paper. Their old Act prescribed a definite scale of charges for domestic uses—that was to say, compulsory uses. Instead of going for a new Act, they obtained a Local Government Order, whereby the Board were clothed with power to sanction scales of charges for water in Birmingham—such scales of charges to be submitted to them from time to time. Having obtained the Order giving the Board this authority, the Water Department then introduced their scale, and had obtained it. The rates were high, for reasons he need not discuss, but with which many members of the Association were more or less familiar. The point, however, to which he wanted to call attention was this: In respect of the city hotels, public houses, restaurants, and clubs, they had introduced what seemed to him, so far as he knew, a new principle, and which he ventured to think contained the germs of a possible way out of many of their difficulties. They all were aware certain uses of water in connection with public houses, for which many of them had been accustomed to make special charges, were declared in the Avery case to be included in the domestic rate, and had therefore to be withdrawn. The value of the licence was included in the rateable value; and a publican might reasonably say he was paying for uses incidental to his trade by such increase of the rateable value. The method they had adopted was this, to offer to allow the consumer in the hotel having the right to demand it, a rebate of 25 per cent. off the full domestic rate, and this, *plus* the charges for baths, or according to the size of the meter, whichever was greater, divided by four, provided the domestic minimum. This was only applicable where premises exceeded £80 a year rateable value. By this method, they made it worth while for a customer to economize in the use of water; the Water Department being protected by the presence of the meter, and the provision that the supply should be charged for according to the meter scale in operation for the time being. They applied the same principle to factories by having a modified domestic rate going down as low as 3 per cent., and then putting in a meter, giving for the domestic rate divided by four a certain quantity of water, as allowed in the meter scale. They had had a revaluation made in cases in which the full machinery was included in the rateable value; and in consequence of this, it had been necessary in cases of *bonâ fide* factories to make still further concessions; otherwise the charges would have been unreasonably excessive. This was the application, not merely by agreement, but by the sanction of the Local Government Board, of the principle to which Mr. Ashton Hill and Mr. Newton referred.

Mr. C. H. Priestley (Cardiff) said it seemed to him Mr. Lees had, in the first place, tried to make out that the flat-rate was not inequitable, and then afterwards that it was so to a certain extent. To him (Mr. Priestley) the flat-rate did seem to be inequitable, for the reasons pointed out by Mr. Newton. But he thought it might have been got over in another way to that suggested by Mr. Lees—in fact, he believed it had been got over in Manchester for a great number of years. He understood that there a penny rate was charged for all purposes of water supply in addition to that for domestic uses. The penny, of course, could be any other amount. It seemed to him that the domestic rate in the first instance should be assessed on a reasonable basis; and if this was not sufficient, then, instead of putting an undue charge upon certain consumers, as the Metropolitan Water Board had done in the City, it might be made a flat-rate in this sense, that the rate was applicable to all premises and in the nature of a rate-in-aid. In connection with the standard rate of charges mentioned by the authors, it seemed to him that no given quantity of water per head was reasonable and proper for every place. They knew quite well that in such places as Brighton, Cheltenham, and many other watering-places, the use of water was considerably more per head of the population than in such places as Sheffield and Manchester. It therefore appeared to him that no equitable basis could be arranged for supplying a given quantity of water per head of the population. His Committee and himself had never found any of the difficulties which seemed to be so prevalent among some other members of the Institution. The Acts of Parliament in their case defined the domestic supply, and the rate to be paid for it; 5 per cent. under £20 rateable value, and 4 per cent. for £20 rateable value and above. Personally, he did not think they could take too liberal a view of the employment of water for domestic purposes, because he believed it was for the benefit of the health of the people that they should use, though not abuse the use of, water as much as possible. The authors pointed out that it could not be denied that modern ideas of sanitation involved a larger consumption of water for domestic purposes than did the ideas existing in the year 1847; and this extra supply had generally been afforded without demur by water authorities. It should be borne in mind, too, that these water authorities had had to lay out more money than was expended by water authorities in 1847. He agreed that some definition should be made as to the question of pure and wholesome water; but he did not think any general definition was applicable to every district in the country. The authors mentioned that, in manufacturing areas, a considerable proportion of the water supply was for trade purposes in factories and workshops; but they might have added many other uses. In his own case, the bulk of the supply was for dock purposes. The trade purposes in Cardiff represented over 12½ gallons per head as against a total consumption of 28 and 29 gallons per head—the rest being for domestic purposes. As to an extra charge for a garden, he believed the garden was incorporated in the assessment of the premises; and he did not think it right there should be anything extra charged for a garden. The authors suggested that to the Legislature, guided by the sanitarian, should be left the prescribing of the dividing-line between domestic and non-domestic purposes. If the "sanitarian" was the medical officer of health, then he thought the water-works engineer was quite as capable of guiding the Legislature.

Mr. F. J. Dixon (Ashton-under-Lyne) hoped the result of the paper and discussion might be the drafting of a small General Bill which could be utilized in future legislation. The whole question of what was domestic supply, was a legal one; but the decisions given by eminent Judges were apt to create confusion. In the Avery case, Lord Justice Buckley asked, "What is the test for domestic supply?" Another said: "The test is the purposes for which the water is being used, and not the character of the premises in which the water is used." Twelve months after, in the Oddenino case, Mr. Justice Sargant said: "The test is the character of the house to which the water is being supplied, and not the purposes to which the water is actually being put." Following these two decisions, he (Mr. Dixon) felt himself in great difficulty. He was going to take the part of the consumer that day, because he felt that a good many private companies were trying to screw the last drop of blood out of the consumer. He believed that an innumerable list of supplies which should not be included as domestic had been irritating to the consumer. Take a house for which the tenant paid £100 a year—a house surrounded by a garden, and with a stable attached, or motor-car house and a cow-shed. The valuer who made the gross assessment would naturally take into consideration everything in arriving at the valuation for rating purposes. Whether a flat-rate or a differential rate was charged for the house, he (Mr. Dixon) contended that there should be no charge for water-closets, washing of carriages, and keeping the cow-shed clean. He had drawn up a clause which he thought applied to his contention. He would have the definition of domestic supply read as follows: "A supply of water for domestic purposes shall include a supply of water to a private dwelling-house when the water is used for washing, drinking, cooking, and sanitary purposes, also a supply of water for baths, water-closets, horses, cows, and for washing carriages or motor-cars, where such are kept for the sole use of the occupier." As to non-domestic supply, his definition was: "A supply of water for non-domestic purposes shall include a supply of water other than for domestic purposes." He did not think they could have a simpler definition for non-domestic supply, as it covered all that was not in domestic supply. Non-domestic supplies, in his opinion, should be measured by meter; and he believed if this were done, there would be no difficulty whatever. It would be more equitable to the consumer.

Mr. William Whitaker, F.R.S., F.G.S., congratulated the

authors upon their boldness in tackling the subject of definition, because, in his experience, the moment one began to define anything, one was landed in almost inextricable confusion. They had, for instance, heard how the Judges of the land differed in defining the word "domestic."

Mr. A. W. Oke thought the use of the paper would be to point engineers to the need of codifying the Acts referring to water supply.

Mr. C. Clemesha Smith (Wakefield) asked whether it was really desirable that they should have the term "domestic" more clearly defined; and, if it ought to be, how were they to attain their end. The authors had endeavoured to put before them several positive difficulties. They had heard others during the discussion; and Mr. Whitaker had shown them how hopeless it was to define almost anything in the world. They were therefore driven to the negative definition, which, as Mr. Antony Lees indicated, worked very well in Birmingham. It seemed to him that the only method left to them was to exclude specific purposes from domestic use.

Mr. F. L. Ball (Mid Kent Water Company) looked at the matter as one responsible for the water supply of rural areas. His Company were strongly pressed to be put under compulsion to supply water to farmers. The argument was that farmers were milk sellers; and they were bound to provide a proper supply of drinking water for the cows, and for the washing of vessels. The Rural District Councils said, as farmers were under this obligation, they ought to be in the position to ask for a supply of water; the Company giving the supply on such terms as they thought fit. The point was met by the Company offering a clause providing for such agricultural purposes; but they guarded themselves to the extent that, in the event of a shortage of water, they should be relieved of the obligation to supply the farmers. It was also provided by the clause that the farmers must pay the expense of extending the mains; while the Company were to keep them supplied at a minimum of £4 for three years. It seemed to him there must be compulsion of supply where, in a water company's or authority's district, Parliament put upon anyone the obligation to provide himself with a proper supply. The speaker next referred to the question of the supplying of premises—say, with a meeting-hall attached. In this connection he read the following clause, which was commonly put into Acts of Parliament when the water-rate was chargeable on the rateable value of any premises entered in the valuation list: "When the water-rate is chargeable on the rateable value *of a part only of any premises entered in the valuation list for poor rate* (such part not being separately assessed to the rate for the relief of the poor), such rateable value shall be a fairly apportioned part of the rateable value of the whole premises ascertained as aforesaid; the apportionment in case of dispute to be determined by two justices." In one case where a meeting place was attached to the main premises (an inn), the consumer contended that the Company had no right to charge on the total of the rateable value, which included the meeting-hall. But the Company pointed out that the persons frequenting the meeting-hall used the lavatory accommodation at the inn, and so the Company were in fairness entitled to charge on the rateable value. They had not found much difficulty in insisting on non-domestic supplies being all metered. In regard to baths and extra water-closets, charges for them were irritating to the consumer.

The President said that in Belfast they had the advantage of defining in a negative way what were not domestic supplies; and they had no difficulty. Parliament had given them power in their several Acts to do this. In their last Act, they were granted power to define some of the more modern uses which they considered were not domestic. They also had rating above the 5 per cent. basis on the valuation, and could work up to 13 per cent. But in their domestic supply they included, free of charge, all baths, water-closets, washing-basins, and things of this sort. Mr. Antony Lees had referred to the question of a flat-rate. They had a flat-rate in Belfast for premises other than domestic. For business premises which were not domestic, they had a rate of charge one-quarter of the domestic, whether or not water was consumed. This was a general charge, for the water-mains were carried past the premises, and they had the advantage of the supply for extinguishing fire.

Mr. Blackburn, replying to certain points in the discussion, said both Mr. Griffith and himself were pleased the paper had given rise to such a good discussion. The object of the paper was to provoke discussion, and to this extent it had succeeded. The idea at the back of their minds in reading the paper was that there should be some amendment of the Model Bill, or some settlement of this vexed question as to what was "domestic supply," and that the Institution should take its proper place in advising on any such amendment, because, owing to the seemingly contrary decisions given in the Law Courts, matters could not rest very long in their present position. "What is a domestic supply?" Did the test turn on the character of the user or on the character of the place of user, or did it turn on both? It was recognized by the authors that it was rather difficult to make very much progress; but it was hoped that there would be some suggestions in the discussion which would enable the Council, who had been considering this matter during the last two years, to take some practical steps. Now, regarding the remarks of the speakers. Mr. Ashton Hill seemed to think it was cheaper to waste a certain amount of water than to adopt meters. To some extent, this was true; but everybody wanted to stop-off objectionable waste. Many generations had grown up to the use of water supply without meters; and so people would strongly object to have water-meters, and to have to pay rent for them. There was the possibility that someone would one day invent a penny-in-the-slot water-meter, as in the case of gas-meters. Mr. Hill said he had no difficulties at all. If he was the sole arbitrator, he could not have a better; and a very great deal did depend upon the tact and the personality of the officials of the water authorities, in order to prevent irritation. Mr. Hill also mentioned the question of trading concerns in his district who got practically the whole of their trade supply from a canal, and only came to the Water Company for a drinking and fire supply. Where a large factory or works using water for trade purposes took a small supply for domestic uses, the question was raised as to making a separate domestic charge apart from the meter charge. One of the points they had to consider there was whether the domestic consumption was at a different time from the trade consumption. The domestic consumption might also be so small that a large trade meter would not register it. In this case the practice he thought—and it was a good one—was to have either a domestic charge separately, with distinct piping not passing through the trade meter, or a small meter for the separate purpose. What the authors were advocating was uniformity of principle for the whole country—not uniformity of charge. Uniformity of charge would have to depend upon the cost of obtaining the water. But they did advocate uniformity of charge in the area of each undertaking. Mr. Newton spoke about distributing the burden of the cost of the water. The water had to be paid for by somebody, and the great object was to distribute the burden of the cost fairly; and he thought that, on the whole, this had been done. Mr. Newton seemed to think that the solution of the problem was section 12 of the 1863 Act; and he advocated continuing the negative tests that they now had, and which had given rise to so much litigation. Mr. Antony Lees mentioned the question of fire insurance. He considered that, because the water authorities laid their mains past premises, there was a great saving on the fire insurance rate; and that this was one reason why water authorities should be allowed to charge for fire purposes. His (Mr. Blackburn's) own authority did charge for fire purposes when the hydrant or main was taken into private premises. Under the Act of 1847, however, they were not allowed to charge when the water was taken from hydrants or mains in public streets. In the case of their President, and in the case of Manchester, where a flat-rate was levied whether or not water was taken, this covered the cost of the charge for fire. Mr. Antony Lees' new principle in the Birmigham scale of charges was distinctly an interesting one, and entailed the charm of a principle which might be largely extended in the future. Mr. Priestley also made the point that in Cardiff they had no difficulties; nor had he (Mr. Blackburn) any, save such as could be overcome. Mr. Priestley finished up by saying that he advised using water as much as possible. It was a dangerous thing to say this, unless they coupled with it the qualification that there should be as little waste as possible. Waste was a thing on which they wanted to lay more emphasis. Mr. Dixon desired to know who was the sanitarian to whom the authors alluded. The authors did not like to suggest that water authorities were the proper people. They were sanitarians if nothing else; and he did not see how matters would get on without consulting the water authorities. Mr. Dixon also said that the provisions of most Private Acts were very irritating to the consumer; and he thought there ought to be no charges for washing carriages, cars, &c. This depended on whether the charge made was high enough to cover these things. If so, he (Mr. Blackburn) would have no objection to this at all. Mr. Whitaker said the authors were very bold, and at the same time very modest. Both Mr. Griffith and himself appreciated that this was a difficult subject to tackle; but they were not deterred by that. Mr. Oke suggested that the proper thing to do was to codify the laws on this question. This was really why the paper was read.

Mr. Percy Griffith, also replying, remarked, in regard to those members who said, because they had no trouble in this matter, they did not think it necessary to take any action, that this was not altogether a wise attitude. Some members of the Council had been looking ahead, and saw the possibility of difficulties which were not contemplated coming along unexpectedly; and they thought it better to foresee and prevent them. They also thought that, the matter being a complicated one, an effort should be made to simplify the general definition, so that the consumers might know what their position really was, and have some reason for accepting it without demur. As to the remarks of the speakers, those who knew Mr. Ashton Hill could well understand that his verdict was readily accepted. But they were not all quite so influential, nor so fortunate in that respect, as Mr. Hill; and he (Mr. Griffith) thought they might reasonably conclude that these difficulties were better dealt with in advance. He had been asked to speak as to the multiplicity of closets, conveniences, lavatories, &c. Each one was a possible—and he thought a constant—source of waste, in practice; and in this respect they should not be considered as involving no further use of water. The multiplicity of such conveniences did sometimes create a little more frequent use; and he thought they ought not to be multiplied indefinitely upon any given scale of domestic charge. He was interested to hear Mr. Antony Lees discuss and defend the flat-rate of the Metropolitan Water Board. This flat-rate had not had many defenders; and he thought Mr. Lees' eloquence was needed to give a qualified support to it. His remarks amounted to this, that, with such a flat-rate, there would be so many exceptions for

special cases that a flat-rate was of very little advantage. At any rate, this was the impression he (Mr. Griffith) got from Mr. Lees' remarks. He was also glad to hear Mr. Lees refer to the Birmingham scale of charges. He (Mr. Griffith) ought to say that, in the consideration given to this subject over the last two years, the Council had had the scale before them, and had appreciated its novelties and its excellencies. But one was tempted to observe the fact that everyone who had a particular scale of charges which he had thought-out for himself regarded it as the most important thing that had ever been proposed, and considered it did not need improving. No doubt Mr. Lees was of opinion that he had something good. Nevertheless, the Council had agreed that a little general discussion of the principles underlying these charges would be very useful. This was the object of bringing forward the subject that day. As to the specific legal case applying to a laundry, the one they had in mind was that in which the Bognor Water Company were concerned, but this was a school laundry. They had not found a specific case for a trade laundry. The President informed him that in Belfast the workhouse laundries were charged by meter separately from the workhouse itself. He was glad to hear Mr. Ball give his experiences in rural areas. These illustrated the desirability of comparing notes under the varying conditions applying to the water undertakings throughout the country. Surely some Model Bill which would be generally applicable, and useful to the consumer as well as to the water engineer, might be framed to deal with this question. He was at liberty to say that the Council would be encouraged by the discussion that day, and would give further consideration to it on practical lines, with a view, if possible, of drafting something which might be worthy of being submitted, in the name of the Institution, to the Legislature.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Exports of Sulphate of Ammonia.

SIR,—With reference to our letter of the 23rd inst., we think it right to inform you that we received a letter from "The Times" on the 28th inst. saying that they fully intended to publish our first letter (copy of which we sent you), but substituted our second letter—published in the "JOURNAL," p. 717—to give us an opportunity of stating our case more fully.

SULPHATE OF AMMONIA ASSOCIATION.
D. Milne Watson, Chairman.

84, *Horseferry Road, S.W.*,
Dec. 30, 1915.

Gas in Train Accidents—Naphthalene Troubles.

SIR,—Two matters referred to in your issue of Dec. 28 are of special interest to me.

I cordially agree with your protest (p. 697) against the unqualified nonsense which is appearing in the public Press as to gas in train accidents. A railway collision is always a terrible matter, and more horrible than ever when fire occurs. But you cannot have white-hot ashes sprinkled over inflammable material without a fire—particularly when there is any wind. It is conceivable, under some extreme circumstances, that the gas lighting of carriages may have some bearing in the matter—indeed, it may be said to have been proved in one case as a contributory cause. But much of the evidence, including the first report of the Board of Trade Inspector on the subject, has been quite inconclusive; and those of us who have had actual experience, and know of the experiments that have been made on the very point of safety, realize how remote the risk must necessarily be. Surely it is obvious that, on violent impact, extinction of lights is almost certain; and, with the inevitable disruption of pipes and cylinders, all gas must be speedily lost. After all, the gas lighting of trains is no new thing. It is in vogue all over the world, with great advantage to the passengers, and has been for many years past. It is only recently, however, that the remarkable allegations have been made concerning the danger.

Now in regard to naphthalene troubles (p. 709), Mr. Carpenter, of Great Yarmouth, in giving his interesting experiences with reference to the "C" process, makes the following statement: "I cannot think, *although it has been stated*, that there is, under varying conditions of temperature, absolute freedom from naphthalene nuisance in the gas services." In view of this, it is permissible for me to refer to the carburation process, presumably forgotten by many, but in use in works at home and abroad. By this process, when applied on the outlet of the governors and regularly and efficiently used on the whole of the gas distributed, it is possible with a small amount of oil to keep the distribution canalization clear of naphthalene, and Mr. Carpenter can be perfectly assured of the fact. He would find here at Hastings, for instance, that naphthalene in the service pipes has been unknown for many years past; and what is possible here, is possible under similar circumstances of application elsewhere.

CHAS. F. BOTLEY.

Hastings, Dec. 31, 1915.

Increased Toluene Production.

SIR,—In the issue of the "JOURNAL" for Dec. 21, the writer of the article dealing with the above subject mentions the use of limestone as a method which has been suggested in the carbonization of coal to attain this object, and that he was intimately connected with experiments to find the effects of liming coal. From the description given, the experiments were in no way connected with increased toluene production, but with the production of metallurgical coke from semi-coking coals high in sulphur.

One point, however—viz., "that when limestone was used the ascension pipes were much freer of carbon during the tests"—shows that the limestone had produced some action by which the cracking of the hydrocarbons was prevented.

The use of limestone was put forward with the special object, when semi-coking and second-grade coking coals high in oxygen were used for the purpose, of retarding the evolution of the hydrocarbons which came off at the early period of carbonization, in order that these hydrocarbon vapours should take up the heat necessary for their formation into more stable compounds.

The writer of the article suggested that gas companies should reduce the temperature of carbonization in order to increase the production of toluene.

Many gas-works are at the present time working to the full capacity of their carbonizing plant, and other works are experiencing great difficulties in obtaining their regular supplies of coal. Any method which requires an increase in the quantity of coal to meet the daily demands of gas would, therefore, be quite out of the question. The use of limestone added to coal before carbonization renders available a lower grade of coal than has hitherto been used.

A series of trials has recently been made at one of our large gas-works on a sample of such coals, with and without the addition of limestone. Ten charges, each of 5 cwt., were carbonized—five coal only and five to which limestone was added. The gas was measured through a meter, and the calorific value determined by a calorimeter after the gas had been standing in the holder a sufficient time to become thoroughly diffused. The following results were obtained:

Coal as Received. Ash Content 26·9 per Cent.

	Coal.	Coal and Carbonate.
Average temperatures inside retort of five charges during carbonization .	1081° C.	1099° C.
Results obtained per ton of coal :—		
B.Th.U. in gas made.	4,535,600	4,984,900
Tar produced—gallons	6·29	9·26
Light oils in tar 0° to 170° C.—gallons	0·313	0·69
Toluene in gas—pounds	1·64	3·13
Toluene in tar—pounds	0·53	1·21

A. ROLLASON.

Nottingham, Dec. 31, 1915.

Gas Affairs at Ripon.

SIR,—Referring to the paragraph in your last issue, *re* the proposed extensions at these works. Will you kindly note that Mr. Matt Dunn, of Stockton, has nothing to do with these works. It should have read Mr. J. Wilfrid Dunn; and I shall be pleased if you will make the necessary correction.

H. F. PEEKS, Manager.

Ripon Gas-Works, Jan. 1, 1916,

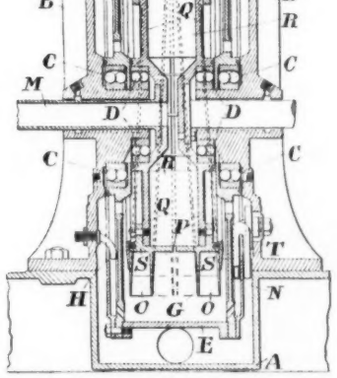
REGISTER OF PATENTS.

Rotary Compressor or Exhauster.

JOHNSTON, J., and GLOBE PNEUMATIC ENGINEERING COMPANY, LIMITED, of Victoria Street, S.W.

No. 22,769; Nov. 13, 1914.

This rotary exhauster comprises two drum-like members arranged one within the other and eccentrically to one another, and having an annular liquid piston occupying the space between the members. The inner member is provided with one or more helical passages through which the gas being operated upon is forced from the inlet to the outlet side.



Johnston's (Globe Pneumatic Company) Rotary Exhauster.

In such devices, the patentees remark, it is well known that the degree of compression or exhaustion depends upon the amount of centrifugal force available for such operations in the liquid of the annular piston—this being determined for a given speed of rotation by

the extent of the immersion in the liquid of the helical passage or passages. It has heretofore been proposed to increase the effectiveness of the machine by making the inner member tapered or conical, in such a manner as to increase the depth of immersion in the liquid of the helical passage through which the gas passes. But such a construction, they point out, suffers from the "grave disadvantage" that a wedging action takes place between the tapered member and the liquid, with the result that the outer casing is often subject to very great stresses, and may be liable to burst.

The object of the present invention is to devise a form of machine of the kind first referred to having the advantages of the second type of apparatus mentioned without its attendant disadvantages; and it consists in a machine of the type first above referred to comprising in combination an outer casing, an inner cylindrical rotary member having one or more helical passages thereon, and a shrouding plate formed or fitted upon one or each side of the inner member.

A transverse sectional elevation is given to illustrate one convenient form of machine in accordance with the invention—applicable more particularly as an exhauster.

A suitable form of foundation A has brackets B thereon for carrying the bearings C D of the outer and inner members respectively—the bearings being disposed symmetrically about the centre line of the machine (as shown) or else arranged so that the members may be overhung. The outer member is in the form of a hollow drum or casing, and the inner member is cylindrical in form and constructed in two parts Q, each of which is provided with two threads G, right and left handed, so that the gas to be extracted by the machine will be drawn through the hollow shaft M by way of the interior of the inner member and through the apertures P to be fed along the inner member to the outer surfaces.

The two parts Q of the inner member are connected by intermediate webs R, and the outer ring-like portions S, carrying the threads G, are secured to the members Q; and in order to provide for an increased effectiveness of the machine as regards the degree of exhaustion obtainable from it, shrouding plates T are provided on each side of the inner member, which, as already stated, is cylindrical in form, so that the plates will provide for an increased immersion of the inlet or outlet for the gas in the liquid of the annular piston, thus causing the gas to be acted upon by an increased centrifugal force and increasing the degree of exhaustion obtainable. The shrouding plates are made somewhat shorter than the stroke of the machine, in order to leave a discharge passage between their edge and the liquid piston at the outer part of the stroke.

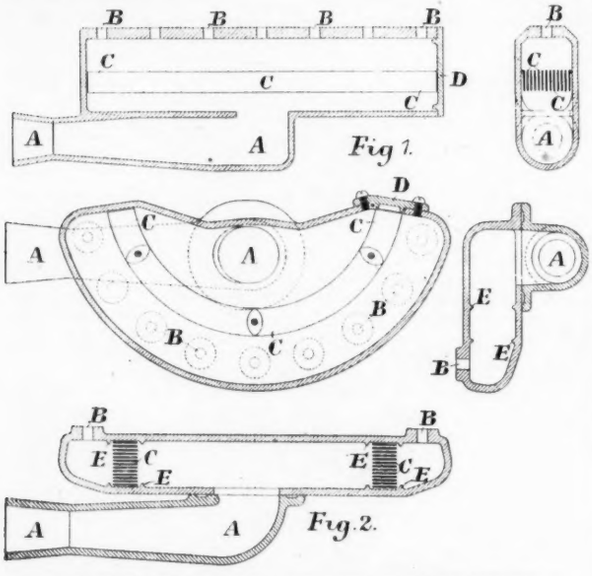
The liquid that is to form the annular piston may be introduced into the space between the two members by the nozzle H, and means are adopted for maintaining constant the amount of liquid within the machine, as, for example, by an outlet scoop N, arranged so that its position may be readily varied according to the quantity of liquid that is to be maintained within the machine.

Gas-Stove Burners.

RICHMOND GAS STOVE AND METER COMPANY, LIMITED, and HARTLEY, H., of Warrington.

No. 23,592; Dec. 5, 1914.

In the burner according to this invention a grid—composed of a plurality of relatively long plates or strips of metal or other solid material, arranged or spaced more or less closely to one another, and the depth of which is substantially greater than their distance apart—is so placed in the gaseous stream inside the burner that the plates are parallel with the direction of flow of the mixture from the inlet to the nozzles, and there is a space between the gas and air inlet and the grid, and between the grid and the gas discharge nozzles or holes at which the gas burns.



Hartley's (Richmond Stove Company) Gas-Stove Burners.

Fig. 1 shows a longitudinal and cross section of one modification, and fig. 2 is a plan, cross section, and longitudinal section of another one.

The burner is of the horizontal elongated type, the body of which is cast in one, and through the bottom of which the combined air and gas are introduced by a horizontal mixing-tube and conduit A. The roof of the body has a number of holes or nostrils B in it, at which the jets of gaseous mixture issuing through them will burn. The body of the burner has parallel sides, and is relatively deep to its width; and in about the middle of the body—that is, between the roof and the bottom—the grid device C is disposed, and extends from end to end, so that a space or chamber exists between it and the roof as well as one below.

The grid device consists of a multiplicity of relatively deep thin plates or strips of metal preferably placed closely together, the relative depth to the width of spaces being several fold. The grid is supported in the body; and all the plates are connected and yet held apart by pins or rivets, with washers between the plates. One end of the body is closed by a cap D, which, when removed, enables the grid to be introduced or removed. Fig. 2 shows the invention applied to a semi-circular burner. The grid here takes the general form of the outside of the burner body and the rows of burner apertures or nostrils B; and the grid bars in this case are in the horizontal plane, and lie within, and are held in place by, the ribs or projections E on the roof and bottom of the burner—they being introduced through a hole at one end of the burner, normally closed by the cap D. The gases in this case enter the body at the back, and then pass through the narrow spaces between the plates of the grid, and so to the space in the burner beyond it—in the roof of which the flame nostrils B are provided.

It is said that: "The effect of the invention is to enable a more even distribution of the gaseous stream through the burner to be obtained; to ensure the removal of violent eddies in the gaseous stream; and to enable a silent flame to be obtained over a wide range of aëration."

Manufacture and Use of Oil Gas.

WESTRUP, C. J., of Great Tower Street, E.C.

No. 345; Jan. 8, 1915.

This invention relates to apparatus used in the manufacture of oil gas consisting of a control valve mounted directly upon the emission end of the vaporizer in such a manner that the passage formed is uninterrupted by bends. In combination therewith is a cone-shaped orifice formed in a block adapted to be inserted within the open end of the supply pipe, and which block is capable of longitudinal adjustment within the pipe—being retained in the positions desired, after longitudinal adjustment, by set screws. Means are also provided for automatically controlling the supply of fuel to the vaporizer.

Economizing Valves.

SYMES, G. V., a communication from the FUEL ECONOMIZER COMPANY, Cleveland, Ohio, U.S.A.

No. 5198; April 6, 1915.

This apparatus is of the type wherein are provided two concentrically mounted rotary valves (one fitting inside the other); the outer or main valve being adapted to be operated by a lever, associated with a member which projects above the main gas-burner—the arrangement being such that the placing of a utensil over the burner depresses the member and causes the main gas-valve to open. The inner or auxiliary valve fitting within the main valve is manually adjustable.

The gas-valve comprises a rotary auxiliary valve mounted within the main valve and locked to it in one of certain selected relative positions by a member on the auxiliary valve adapted to engage with projections or slots upon the main valve, so that, after adjustment, the auxiliary valve moves with the main valve, whereby, in accordance with the adjustment of the auxiliary valve, the supply of gas to the burner is regulated independently of the movement imparted to the main valve by the displacement of the lever connected with it.

Oil-Gas Generators.

MITCHELL, W., of Malden, Mass., U.S.A.

No. 5830; April 19, 1915.

The chief objects of this invention are to provide for the regular and efficient generation of oil gas and the perfectly even discharge thereof; to ensure its fixed dry clear character or quality; and to ensure the complete reduction into gas of all the gas-producing elements of the fuel without permitting any of the latter to become burned or baked before generation, and consequently accumulated on the walls of the generator. To these ends a generating retort is employed of the type having a sleeve-form elongated fuel-space which is thin at all points, but diminishes in the thickness of such space from its inlet to its outlet end, so that the walls of the space necessarily offer a continual increase of resistance to the gaseous flow—on somewhat the same lines as those described in Galkin's patent No. 5368 of 1902 and Gardiner's patent No. 8028 of 1912.

APPLICATIONS FOR LETTERS PATENT.

17,765.—BURT, E. M. S., "Gas-cooker." Dec. 20.
17,843.—CWIBEL, B., and HORA, T. T., "Mantles." Dec. 21.
17,867.—BIRCH, G., "Inverted burners." Dec. 22.
17,894.—WHITE, A. E., "Treatment of coal gas." A communication from the Riter-Conley Manufacturing Company. Dec. 22.
17,902.—KEITH, J. & G., "Crucible furnaces." Dec. 22.
17,984.—CLARKE, W. C., "Gas-cooker." Dec. 24.
17,993.—HUNTER, T. M., "Atmospheric burners." Dec. 24.

MISCELLANEOUS NEWS.

SOUTH SUBURBAN GAS COMPANY'S CO-PARTNERS.

Message of the Directors.

The South Suburban Gas Company Co-Partnership Almanack for 1916 contains the following Directors' message (signed by the Chairman, Mr. Charles Hunt) to all the Company's co-partners.

The Chairman and Directors have again the pleasure of sending to all co-partners their best wishes for a New Year. May it bring happiness to all! May it restore to the nations the blessing of peace! Seventeen months of unparalleled warfare, chequered by atrocities that cry aloud for retribution, and must for ever stain the German name, have not shaken the unity of the Allies, nor their high resolve. On the contrary, the appearance of fresh enemies has but nerved them to fresh exertions with ever-increasing strength—a sure presage of final victory. We are all proud of the large number of the Company's employees who are taking part in this great war of liberation, and also of the heroic engagements in which many of them have shared. They have our earnest wishes for their continued safety and success, and for the complete recovery of those of them who have unfortunately been wounded. And we should be ungrateful indeed did we not acknowledge with reverence our deep indebtedness to those who have laid down their lives in fighting our battles. To those whom they have left behind, we tender heartfelt sympathy on behalf of all. The generous contributions to the War Fund of all classes of employees have much impressed the Directors, who gladly welcome this co-operation as an additional bond of union. They desire also to acknowledge the valuable services which are being rendered by the Special Committee of employees in administering the fund, which it is gratifying to know is proving a real benefit to the many dependants of those on active service.

LEEDS UNIVERSITY LECTURES.

Department of Coal Gas and Fuel Industries (with Metallurgy).

In connection with the work of the department, arrangements have been made by Professor John W. Cobb, B.Sc., F.I.C. (Livesey Professor) for the delivery during the second term of the session 1915-16 of the following special courses of lectures, open to all persons engaged in any branch of the industries concerned.

I.—THE CHEMISTRY OF COAL AND CARBONIZATION.

A series of six lectures by Professor John W. Cobb, B.Sc., F.I.C., will be given on Wednesdays, at 6 p.m. and 8 p.m., commencing Feb. 16, and continuing until Wednesday, March 1.

Coal—its origin and composition. Classification and valuation of coals in respect of their principal economic uses—*e.g.*, for steam raising, gas making, furnace firing, manufacture of coke, &c. Recent investigation on the nature of the constituents of coal and the mode of occurrence of nitrogen and sulphur in coal. The influence of temperature on the carbonization of coal, with special reference to the character and yields of gas, ammonia, coke, and tar-constituents, including benzine and toluene.

II.—REFRACTORY MATERIALS.

A course of eight lectures by Professor John W. Cobb, B.Sc., F.I.C., will be given on Tuesday evenings at 6 p.m., commencing on Tuesday, Jan. 18.

Physical and chemical introduction. The properties and composition of the raw materials. The principles and methods of manufacture and testing. Silica, ganister, alumina, bauxite, kaolin, fire-clays, magnesia, chromite, graphite, dolomite. Grinding, grading, moulding, pressing, drying and burning, shrinkage, expansion and contraction, refractoriness. High temperature furnaces and testing. Choice and use of refractory materials for gas retorts and settings, coke-ovens, steel and metallurgical furnaces.

III.—EVENING LABORATORY COURSE.

The laboratory of the department will be open on Wednesday evenings between 6 p.m. and 9 p.m., from Jan. 19 to Feb. 9 inclusive, for a limited number of students who have already received some chemical training, but who desire a knowledge of analytical methods for the estimation of benzene, toluene, &c., in coal tar and gas, and the examination of crude benzol and toluol.

[Attention is called to the possibility of attending both Courses I. and III.]

IV.—DAY LECTURE COURSES, 1915-16.

For information respecting the day lecture courses in the Coal Gas and Fuel Industries Department of the University—namely, in chemistry of gases, technology of fuel, gas-producer practice, general and non-ferrous metallurgy, blast-furnace practice, iron and steel, alloys and metallography—see the special prospectus of the department, obtainable on application to the Secretary.

V.—ADMISSION OF STUDENTS, INQUIRIES, &c.

Intending students are requested to send in their names without delay to the Secretary of the University, specifying at the same time what course or courses they wish to attend. Other inquiries regarding the courses should be addressed to Professor Cobb, the Head of the Department of Coal Gas and Fuel Industries.

The University reserves the right to decide that any course shall not be given if the number of entries is inadequate, or if the technical services of the Department are further requisitioned for national purposes.

COLONIAL GAS ASSOCIATION, LIMITED.

The Treasury and the Association—Good Progress, but Revenue Temporarily Used for Capital Purposes.

The Ordinary General Meeting of the Association was held last Thursday, at the Cannon Street Hotel, E.C.—Mr. SAMUEL SPENCER in the chair.

The SECRETARY (Mr. Alfred J. Kingdon) read the notice convening the meeting and the Auditors' report; and the report and accounts [see "JOURNAL" Dec. 28, p. 714] were taken as read.

The CHAIRMAN, in moving their adoption, said his first duty was to say, with the deepest regret, that since the last meeting they had lost their colleague, Mr. W. Swinburne. He was associated with the Company from its start; and his assistance was of the greatest benefit since his brother (the Hon. George Swinburne) left them. He became, as the shareholders knew, their Managing-Director. His loss to the Company was irreparable, as he was so much respected in Melbourne by all who knew him. The Board at once sent out their sympathy and condolence to his family; and he (the Chairman) was sure the shareholders would endorse what was done. The Directors were extremely sorry that the annual meeting was not held as usual, in the early part of November; but, through the war, they could not get the accounts over in time. Since then, and indeed only a few weeks before, the Directors were doing all they could to induce the Lords of the Treasury to allow them to make an issue of shares among the shareholders. This they had refused, although the Directors put the Company's position before them as strongly as they could—pointing out their commitments, in March of last year, as to the payment for the works the Company bought, as well as the expenditure incurred in bringing the works up to the last improvements in gas making. It was particularly pointed out to the Treasury, too, that some £4000 was spent on a new main, partly for the supply of a munitions factory in Melbourne. Why therefore the Treasury should have treated the Company so badly they could not understand. Their reply a fortnight ago suggested that the Company should obtain the capital in Australia. The Directors had informed them that this was an English Company, and about 70 per cent. of the shareholders were English; and they were now awaiting their final reply. At the annual meeting last year, they had had a year's working before the war; and the shareholders would remember it was a very prosperous one. In putting before them the present balance-sheet to the end of June last, he might say that eleven months out of the twelve were in the period of this outrageous and wicked war; but Australia had suffered less financial inconvenience than anywhere else. He thought it could be said of Australia to-day that it was prosperous, notwithstanding the severe drought it passed through in the early part of this year. Had it not been for the war, the Directors felt confident the balance-sheet for the past year would have been equally good, if not better. It was, however, in the opinion of the Directors a most satisfactory one, as the earnings enabled them to recommend a final dividend of 3 per cent., making 6 per cent. for the year. But this was tinged with much regret that the money was not available for immediate payment, owing to the circumstances he had previously mentioned. To get over this, they were having an extraordinary meeting at the close of the ordinary meeting, in order to obtain the sanction of the shareholders to the issue of 6 per cent. preference shares, which the Directors thought they would readily agree to, as the rate of dividend would be the same as they were paying on the ordinary shares for the present year, and which they quite anticipated would, in all probability, be increased in the coming year. He should like the shareholders to think the Company was one that should be considered an investment Company; and no better proof of this could be mentioned than that, during the past year, the transfers had only been eight, three or four of which arose from deaths. He wished to remind the shareholders that this was their twenty-seventh annual meeting, and dividends had from the first been paid half-yearly, during the months of April and November, without any break whatever. In turning to the balance-sheet, the shareholders would see that the profit they had to deal with was £6064. To pay the dividend now declared, less tax, required £4232, with a carry-forward of £1832, against £1774 last year. This, to his mind, showed a record that few gas companies at home or abroad exceeded. The shareholders would notice the Directors had written off for depreciation £1294; and they had increased the reserve fund (£8422) before arriving at the balance for the dividend now recommended. Regarding the new works, Footscray and Oakleigh, they quite expected great results, and felt confident they would not be disappointed, as the increased demand arose from 387 new consumers, and an addition of nearly 600 cooking-stoves. The returns for the current year—from June to November—showed a satisfactory increase of from 15 to 20 per cent. Fortunately, they were able to secure in Australia all the coal they required; and the price had not increased more than 5 to 10 per cent., and this arose principally from the distance of the works from the collieries. The two half-yearly voluminous reports from Australia were on the table, and could be seen by any shareholder desiring to examine them. They would be found as satisfactory to them as they were to the Directors. It might be of interest to the shareholders to mention that the capital account per million cubic feet of gas sold had been reduced during the past year by over £200. It stood at June 30, 1915, at £1338, against £1547 the previous year. To those who know the working of foreign gas companies, this was an exceedingly low figure. He felt convinced that in the near future they would be down to £1000 per million. He should also like to say regarding their fifteen gas-works that at several the price of gas had been reduced, and no increase had been made at any of them. Altogether, considering the extra cost of materials, higher wages, and taxes, the past year's working could only be considered as very good. In conclusion—it was perhaps unwise to prophesy—he did not hesitate to say with much confidence, that he anticipated this year would exceed in prosperity any year of the Company's history.

Mr. CHARLES HUNT seconded the motion, which was unanimously carried.

The CHAIRMAN moved the declaration of a final dividend of 3 per

cent., less income-tax for the year ended June 30 last, making, with the interim dividend, 6 per cent. for the year—the final dividend to be paid as soon as funds were available.

The Hon. Sir JOHN W. TAVERNER, K.C.M.G., in seconding, said he should like the shareholders to understand that what they had to bear in mind was what was said in the first paragraph of the report. The Directors had there been rather lenient with the Treasury; and as he was (so to speak) the Australian section on the Board, he felt very keenly indeed the "Little Englander" policy that was being pursued by the Treasury. Here was a gas company, which had been in existence 27 years, and had paid regular dividends; and just prior to the war the Directors accepted a responsibility in good faith that they would be able to get the necessary capital to carry out their contracts. This they would have done had it not been for the extraordinary policy adopted by the Treasury, who seemed to look upon Australia as not being part of the British Empire. Australia had volunteered service to the Mother Country in connection with the war. It had given money and the service of its men in a manner that had satisfied the bulk of the people of the Mother Country. It had been loyal, and had shown it wanted to be part of the Empire. And it was a most extraordinary, unbusinesslike, and stupid policy of the Treasury to try to make it appear that Australia was not within the Empire. Why he felt it much more keenly and strongly was that there were other interests in this country in connection with which the Treasury, without the slightest hesitation, sanctioned the issue of new capital. Only the other day they sanctioned £7000 to the German Athenæum Club; and they were allowing German interests to earn about three million pounds a year here. But British interests on this side of the water were told they might raise capital on the other side. Now Australia was under no obligation to the Mother Country so far as the war was concerned. Nevertheless, it pledged itself to raise fifty millions of money to help to fight the war to a successful issue; and he thought the Treasury was taking up an extraordinary and unimperial attitude. In effect, Australia was told that it was not part of the Empire—that it was 13,000 miles away; and the policy of the Little Englanders towards Australia was that it must "paddle its own canoe." Australia did not say this to the Mother Country. And because this Company were not allowed to raise the paltry amount of capital they asked for—and be it marked, capital required to carry out obligations entered into prior to the war—the Directors had to take from the shareholders what they were entitled to, and apply the profits to carrying out works that essentially belonged to the capital account. It was a small amount; but its smallness did not stand so much in his idea as the extraordinary policy of the Treasury of this country. He wanted to mention this in seconding the resolution, because the Company had earned the money to pay the dividend, the Company were solvent, the Company were doing well, but through this wretched, narrow-minded, red-tape administration of a few men who had no legal powers, and little knowledge of business, the Directors were obliged to tell the shareholders: "We declare a dividend; and, as soon as the funds are available, you will get it." "As soon as the funds are available" meant as soon as the Treasury would come down, and do the right thing. Then the Directors would at once pay the dividend.

Mr. D. T. LIVESEY said the "storm in a teacup" to which they had just listened struck him as rather curious. If he understood the position rightly, the very action of the Treasury brought Australia in as a member of the Empire. The Government were treating English firms and companies in the same way as they were treating this Company. If this were the case, then the argument was working on the other side. Instead of Australia being treated to a paltry, red-tape policy, the Treasury were simply treating Australia as the Mother Country was being treated.

Sir JOHN TAVERNER: I was speaking in the interests of the shareholders, and not of foreigners.

Mr. LIVESEY: English gas companies are suffering from the same cause.

Mr. HUNT: Not English gas companies?

Mr. LIVESEY: Yes; English gas companies. While they were all sorry with regard to this state of things, they had to be patriotic in this matter. They had to be English, and Australia at the same time British; and all must do what they could. By postponing their dividend for a time (true, he was only a small shareholder), they were doing a little to help in the present crisis, and, in doing this little, were doing the best they could.

Mr. HUNT: Does Mr. Livesey know of any English gas companies who are in any way manufacturing munitions of war who are being refused sanction by the Treasury to raise money?

Mr. LIVESEY: No.

Mr. HUNT: We are doing that.

The CHAIRMAN said the Chairman of Barclay's Bank, who was a great financier in the City, said he could not understand this action of the Treasury; and he (Mr. Spencer) did not think anyone else could.

The motion was unanimously adopted.

Mr. F. R. SMITH proposed the re-election as Directors of Messrs. Charles Hunt and Samuel Spencer. He remarked that Mr. Hunt brought with him to the Board a wide experience of gas affairs, and great technical knowledge of all the engineering details in connection with gas-works; and he was a source of much strength to the Board. They were glad, indeed, to have such an eminent engineer to advise them on technical points. As to their Chairman, they had had experience of his optimism at the present meeting. He inspired them all with his confidence. A Director from the inception of the Company, he had been Chairman for upwards of twenty-one years; and he (Mr. Smith) was sure they could wish for no better.

Mr. H. KING HILLER seconded the motion, which was cordially agreed to.

The CHAIRMAN and Mr. HUNT having acknowledged the continued confidence of the shareholders,

On the motion of Mr. W. RICHARDS, seconded by Mr. LIVESEY, the Auditors (Messrs. Wood, Drew, and Co.) were re-appointed.

The CHAIRMAN moved a vote of thanks to, and confidence in, the Australian Directors and staff. He observed that they had an experienced Chairman over there in Mr. Philip Holmes Hunt, who had had a fine training in this country, and then had been with the Melbourne Company for about ten years. He left the Company a little time ago, and had joined the Colonial Gas Association, and he was rendering them great service. Mr. S. E. Figgis, the Managing-Director, was elected last year. He was compensating to some extent the loss sustained through the death of Mr. W. Swinburne. In Mr. Figgis they had an excellent Director. Their fifteen stations required a good deal of looking after; and, the works being a long distance from each other, they could each be visited only a few times a year. But those in charge of the stations had the full confidence of the Board; and the work they did, as shown by the report, was entirely to their credit.

Mr. HUNT seconded the motion; and it was heartily agreed to.

Subdividing the Shares—Option of Shares for Dividend.

An Extraordinary General Meeting was then held for the purpose of (if thought fit) passing these resolutions as special resolutions:

(1) That each of the 50,000 ordinary shares of £5 each in the capital of the Company be subdivided into five shares of £1 each.
That of the shares subdivided as aforesaid and remaining to be issued 30,000 thereof be issued as preference shares, conferring on the holders thereof a preferentia dividend out of the profits of the Company of each year, at the rate of 6 per cent. per annum, and ranking as regards repayment of capital in priority to the ordinary shares.
That the Directors be authorized to issue the said preference shares as and when they shall think fit, and in such manner and upon such terms as they shall determine.

(2) That the following words be added at the end of Article 102, viz., "The Directors may, however, with the sanction of a general meeting, instead of paying any dividend to the members in cash, divide amongst the members in proportion to, and not exceeding, the value of the amount of dividend to which they would be entitled, any assets of the Company in kind, and in particular any unissued shares or any securities of the Company, or any shares or securities held by the Company."

The CHAIRMAN said he did not think it necessary to say much as to what was proposed by the resolution beyond that further capital was required for carrying on their very successful and satisfactory business with its excellent prospects, seeing that Australia from now must have abounding prosperity. He felt confident that shareholders and friends would come forward and take up the 6 per cent. preference shares in such amounts as would meet the present requirements. As he had already said, the prospects were such as would enable the Company to pay 6 per cent. or more on the ordinary shares, so that the preference shares now offered might be fairly looked upon as a sound investment. Several shareholders had already agreed to take 10 per cent. of what would be issued. An alteration of the £5 shares into £1 shares had been for a long time spoken about, and was especially asked for by the Australian shareholders, as £5 shares were not very much liked on the Melbourne Stock Exchange. In regard to clause 2 and the alteration to the Article of Association, No. 102, it was thought advisable to make the addition suggested; and the Directors would be pleased if the shareholders would agree to it. He moved that the resolutions, as read by the Secretary, be approved and adopted.

Mr. HUNT seconded the motion.

Sir FREDERIC PAINTER asked whether the voting power, one vote for each share, would apply to the £1 shares.

The CHAIRMAN: Yes.

Mr. G. MAY asked whether, in the event of the dividends being taken out in shares, would the dividend start from the time it should have been paid under ordinary circumstances, or from the time of the issue of the shares?

The CHAIRMAN said he thought that went without saying.

Mr. SMITH said, if they paid the dividend in cash as the Directors hoped to do if they could get the shares issued, then the cash payment would be for the dividend which was being declared that day. If, on the other hand, they issued shares for the amount of the dividend, it would be the same as if they were issuing them for cash. However, it had not yet been decided whether or not the dividend should be paid in shares or cash. Of course, in the event of shares being taken, odd amounts of dividend would be paid in cash.

Mr. T. K. GRIFFIN: What is the advantage of the subdivision of the shares? It seemed to him they were going to a great deal of trouble over this matter without deriving any advantage. Was the £1 share really more marketable on the Australian market than the £5 share? For the home market, he did not think that the £1 share would be of greater advantage than the £5 share.

The CHAIRMAN replied that two or three times when they had been placing shares, the Australian market had said that £1 shares would be better. When Sir John Taverner first joined the Board, one of his first inquiries was, "Why do you not have £1 shares, instead of £5 shares?" This was regarded by the shareholders as an investment Company, as was proved by the fact that they only had four transfers of shares this year. There was not another company in England of which he knew which showed anything like that. The shareholders simply held the shares until they died, or there had to be forced sale through liquidation or something of the sort. For an English company, it did not matter much whether the shares were for £5 or £1.

Mr. SHOTTER said he was a trustee. As such, he was not able to accept new shares instead of dividend. What was his position?

The CHAIRMAN: We should only allot them to you at your request.

Both resolutions were unanimously agreed to.

Sir FREDERIC PAINTER moved a vote of thanks to the Chairman and Directors, with whom, he said, the shareholders sympathized while sympathizing with themselves.

Mr. MAY seconded the motion, which was cordially passed.

The CHAIRMAN thanked the shareholders on behalf of the Directors and himself. The last three or four months—ever since they had been concerned about getting further capital—had been very anxious ones for them. Naturally they thought that they would have been able to go on the old lines, and that the shareholders would take up the new capital *pro ratâ*. However, they were getting over their difficulties as well as they could; and, after this meeting, the Board would feel stronger than before, because they knew the shareholders were backing them up.

RATES AND CHARGES IN VARIOUS TOWNS.

Comparative Statistics.

A copy of the annual tabulated statistics which for many years past have been compiled by the Borough Treasurer of Preston is to hand; but unhappily it no longer bears upon it the name of Mr. James Carter. Since that gentleman's death, the work of preparing the figures has been undertaken by his successor at Preston, Mr. W. Allison Davies; and as the result, there are now available particulars with regard to the charges made for gas, electricity, and water, and profits and losses on municipal undertakings, together with the rates levied, in a number of Provincial towns and some of the Metropolitan boroughs for the year 1915-16. There are on the present occasion 137 places referred to, which is three more than last year. Six new entries appear (Canterbury, Clitheroe, Haslingden, Middleton, Morecambe, and Mossley); while figures for three towns (Devonport, Scarborough, and Wallsend), which were given before, are omitted. The populations range from 891,234 in Birmingham to 13,000 at Clitheroe.

Glancing over the statistics it is noticed that, of the places referred to, the rateable values are highest in Westminster (£6,862,627), Liverpool (£5,004,907), Birmingham (£4.822,768), Manchester (£4,797,516), Kensington (£2,446,849), Leeds (£2 235,130), Sheffield (£2,059,213). They are lowest in Clitheroe (£51,624), Mossley (£65.974), Morecambe (£78,050), King's Lynn (£86,342), Haslingden (£90,047), Ilkeston (£90,339), Brighouse (£91,092), and Bacup (£91,844). The places rated at 9s. or over in the pound are: Birmingham, 9s.; Huddersfield, 9s.; Preston, 9s.; Stockport, 9s.; and Worthing, 9s.; Macclesfield, 9s. 1d.; Manchester, 9s. 1d.; and Salford, 9s. 1d.; Keighley, 9s. 2d.; Leigh (Lancs.), 9s. 2d; Nelson, 9s. 2d.; Rochdale, 9s. 2d.; West Bromwich, 9s. 2d.; and Wolverhampton, 9s. 2d.; Harrogate, 9s. 4d.; Stockton-on-Tees, 9s. 4d.; and Warrington, 9s. 4d.; Bacup, 9s. 6d.; Morecambe, 9s. 6d.; and Swansea, 9s. 6d.; Ashton-under-Lyne, 9s. 7d.; Brighouse, 9s. 8d.; Sheffield, 9s. 8d.; Bradford, 9s. 9d.; Stalybridge, 9s. 9d.; Chesterfield, 9s. 9½d.; Colchester, 9s. 9½d.; Hull, 9s. 10d.; Heywood, 9s. 11d; Walsall, 9s. 11d.; Batley, 10s.; Colne, 10s.; Leeds, 10s. 1d.; Rotherham, 10s. 1d.; Stoke, 10s. 2½d.; Lowestoft, 10s. 3d.; Halifax, 10s. 4d.; Ilkeston, 10s. 4d.; West Ham, 10s. 7d.; Merthyr Tydfil, 10s. 9d.; East Ham, 11s. 1d.; Norwich, 11s. 6d. The towns which are rated at 5s. or less in the pound are: Oxford, 4s. 8d.; and Blackpool, 5s.

Out of the rents of property and profits transferred from municipal undertakings, &c., the rates are reduced in the following towns to the extent of 1s. or more in the pound: Yarmouth, 1s. 9d.; Nottingham, 1s. 5d.; Darlington, 1s. 3d.; Stafford, 1s. 3d.; Wallasey, 1s. 2½d.; Halifax, 1s. 1d.; Liverpool, 1s. 1d.; Rotherham, 1s. 1d.; Bradford, 1s. On the other hand, profits equal to only 1d. in the pound, or less, were contributed at Eccles, ¼d.; Mossley, ¼d.; Stoke, ¼d.; Heywood, ½d.; Kingston-on-Thames, ½d.; Colne, ¾d.; Eastbourne, ¾d. (electric light and tramway profits to reserve fund); Newport (Mon.), ¾d. (water, electric light, and tramway profits to reserve fund); West Hartlepool, ¾d. (electric light and tramway profits to reserve fund); Accrington, 1d.; Bacup, 1d.; Brighton, 1d.; Canterbury, 1d.; Hammersmith, 1d.; St. Helens, 1d.

Out of the total of 137 places which are included in the list, about 30 contributed no profits to the reduction of the rates, though half-a-dozen of these earned profits which were carried to reserve. Another table sets forth 67 instances [in many cases, of course, the same towns which showed profits on some undertakings made a loss on others] in which the rates were increased in consequence of deficiencies resulting from the working of one or more municipal trading undertakings. The largest of these deficiencies was at Bristol (£92,152); while Birmingham (£61,549) comes next, and Preston (£39,740) is third. In the case of Birmingham, £43,387 of the loss arose over the water-works; but with Bristol and Preston the cause is not definitely stated—though presumably dock works were responsible. There were also water-works losses of £24,997 at Swansea, and £24,667 at Stockport. The only instance of a loss on gas is at Liverpool (£400), where the works concerned have since been taken over by the Gas Company. Deficiencies on account of electric lighting are, however, reported from Accrington, Bath, Heywood, Ilkeston, Ipswich, Kingston-on-Thames, Lowestoft, Middleton, Morecambe, and West Ham. At Bacup, 2s. 1d. in the pound was added to the rates by the loss of £8126 on the water undertaking. The deficiencies at Bristol caused an increase of 1s. 0¼d., at Preston of 1s. 10½d., at Heywood of 1s. 8d., at Harrogate of 1s. 6½d., at Ilkeston of 1s. 3½d., at Stockton-on-Tees of 1s. 3d.

The remaining section of the statistics deals with the charges made for gas, water, and electricity in the various towns. This shows that, for the places included, the net price of gas for domestic lighting supply is highest at Lowestoft, with 3s. 10d. per 1000 cubic feet; while Widnes remains lowest with 1s. 3d. per 1000 cubic feet, and a smaller rate for large consumers, engines, &c. The other towns in which the charge for gas for domestic lighting is 2s. or less per 1000 cubic feet are: Sheffield, 1s. 9d.; Sunderland, 1s. 9d.; Bath, 2s.; Belfast, 2s.; Burton-on-Trent, 2s.; Newcastle-on-Tyne, 2s.

The charge per Board of Trade unit for domestic supplies of electricity ranges from 6½d. (flat rate) at Bromley, 6½d. at Chatham, 6½d. at Hove, 6d. at Bournemouth, 6d. at Kingston-on-Thames, and 6d. at Oxford, down to 2½d. at Southampton, 2½d. at Bury, 3d. at Accrington, 3d. at Belfast, 3d. at Birmingham, 3d. at Burnley (flat rate), 3d. at Hammersmith (flat rate), 3d. at Hyde, and 3d. at Stalybridge.

The charge for water for domestic purposes on a house of £15 rateable value is highest in Canterbury at 5s. 3d. in the pound; Middleton, 2s. 6d.; Bacup, 2s. 5½d.; Lincoln, 2s. 4d. (within the city limits); and Leicester, 2s. 1d. The rate is 2s. in the pound at Birmingham, Bury, Harrogate, Haslingden, Heywood, Huddersfield, Leigh, Rawtenstall, Rochdale, and Rotherham. The charges are lowest in the following towns: Liverpool (within the city limits), 6d. in the pound; Southampton, 7d.; Worcester, 8d.; Worthing, 8d.; King's Lynn, 8¾d.; Brighton, 9d.; Hove, 9d.; Leamington, 9d.; and Manchester (within the city limits), 9d. The charges are also less than 1s. in Bournemouth, Crewe, Gloucester, Oxford, Peterborough, Plymouth, Reading, Richmond (Surrey), Widnes, and York.

At Preston, the rates are 9s. in the pound; and they are relieved to the extent of 8¾d. in the pound by the profits transferred from reproductive undertakings. These profits are, however, far more than offset by the deficiencies, which it is calculated were the cause of increasing the rates by 1s. 10½d. in the pound. The price of gas at Preston for domestic lighting is 3s. per 1000 cubic feet; of electricity, 5d. per unit; and of water, 1s. 6d. in the pound on £15 houses.

COAL SMOKE AND ECONOMY.

The following letter on the subject of "Coal Smoke and Economy" has been addressed by Dr. H. A. Des Vœux (the Hon. Treasurer of the Coal Smoke Abatement Society) to the "Yorkshire Observer."

The case for the abatement of the smoke nuisance in our cities has always been very strong from the point of view of national health and economy. While those considerations still apply, and in present circumstances with increased urgency, the case against the burning of crude coal to-day stands on even stronger ground—namely, that of national safety. At the present moment the coke-ovens and gas-works of the country are doing their utmost to supply the Government with their enormous requirements of the raw materials—such as toluol and benzol—for the manufacture of high explosives. These materials are obtained from the tar which is extracted from the gas after it leaves the ovens and retorts. When coal is burnt crudely on the domestic hearth, in the kitchen fire, or under the factory boiler, all chance is lost of recovering these vitally necessary materials, as they then, with other tarry and sulphurous vapours, pass up the chimney to darken our skies, deteriorate our buildings, kill our vegetation, and contaminate our lungs.

It is estimated that of the coal raised and consumed in this country no less than 66 million tons (or rather more than one-third) are consumed in factories, and 34 million tons in domestic grates. As each ton of coal contains from 20 to 30 lbs. of sulphur (from which that valuable fertilizer of the soil, sulphate of ammonia, can be made), and from 10 to 11 gallons of tar (from which the raw materials for high explosives, as well as other valuable materials, are obtained), it is clear that both in the factory and in the domestic fire the waste of these substances is very great. To this must be added—a point on which stress has often been laid—the inefficient combustion of the coal itself. Waste at any time is deplorable; but in these days when labour is at a premium, when economy is being raised from a virtue to a necessity, and, above all, when this particular form of waste deprives our fighting men of that superabundance of explosive material which would help to shorten the war, it is more than deplorable—it is criminal.

Owing to the failure to appreciate the work of economic value which has been performed for many years by the Coal Smoke Abatement Society, subscriptions since the war have fallen off to such a degree that we have had seriously to curtail expenditure, and to discuss the possible closing-down of the Society. A due evaluation of our past would have shown that it is in no small measure owing to the remarkably successful propagandist work of the Society in arousing and stimulating interest in all forms of smokeless heating, that high explosives are now available in such large quantities—quantities which might have been immensely increased had our teaching not fallen on so many deaf ears.

EXPORTS OF SULPHATE OF AMMONIA.

Further Correspondence in the "Times."

Extracts were given on p. 717 of last week's issue from letters which had been appearing in the "Times" on the subject of exports of sulphate of ammonia and the requirements of home farmers. One of the correspondents was Mr. Roger W. Wallace, who urged that the sulphate of ammonia exported to Holland is not for agricultural purposes, but for the manufacture of high explosives in Germany. To this Mr. D. Milne Watson (Chairman of the Sulphate of Ammonia Association) replied that "Mr. Roger Wallace has apparently not heard of the success of the Haber process in Germany, and implies that synthetic nitrogen is only being made to a large extent in neutral countries. The facts are otherwise. The Badische Company are at the moment, according to their own account published in German newspapers, producing at the rate of 300,000 tons of sulphate of ammonia per annum, and in view of the increase in the production of cyanamide in Germany, it seems more than probable that the German claim that they are independent of nitrogen from outside sources is perfectly correct."

A further letter from Mr. Roger Wallace was published in last Wednesday's issue; and in the course of it, he said: "Mr. Watson suggests that I have not heard what has been done recently in Germany in the manufacture of synthetic nitrogen. I have always been interested in these products (although I have not made them commercially) since I put down the works for the Gas Light and Coke Company which secure him the position he holds as present Chairman of the Association. Recently in my own laboratory I have tried all the known processes, and others. Mr. Watson gives the figures of the output of a German Company for and against whom I often acted as Counsel, and consequently have not forgotten their claims. It is well, however, to bear in mind that it is essential for the German Government to show that it has enough home material to make its own explosives without having recourse to imports. It is a part of the Press campaign. Mr. Watson sums up by saying: 'In view of the increase in the production of cyanamide in Germany, it seems more than probable that the German claim that they are independent of nitrogen from outside sources is perfectly correct.' Now, Mr. Watson ought to know that cyanamide is made from carbide of calcium, which is not made in Germany, except in very small quantity, but is practically all imported. This ought to be stopped, as well as the cyanamide. Sulphate of ammonia has been the saving of the German agriculturist; and I hope it will not be also of its explosive manufacturers. If the Board of Agriculture stops the export to enemy countries, it could help the farmers to buy the excess; and Mr. Watson's Association would gain now and in the future by having a more extensive demand for their commodity."

TECHNICAL INSTRUCTION IN THE GAS INDUSTRY.

A Report Forwarded to the London County Council by the Education Committee.

The London County Council have formally received a report—forwarded to them by the Education Committee—of H.M. Inspectors of Technical Instruction relating to the Gas Industry in the Administrative County of London, for the period ended July 31, 1914. The Inspectors are Mr. A. Schwartz, H.M.I., and Mr. J. W. Helps, M.Inst. C.E. It was pointed out by the Board of Education that the report [some of the main portions of which are now produced] deals with the extent to which use is made of existing provisions for technical instruction, and with the efficiency of the instruction given at certain institutions, and makes suggestions for the training of gas-fitters' apprentices and students of gas engineering and manufacture. The Board added: "The report does not call for any special action on the part of the Council at the present time, except in regard to the directions in which future developments should take place. We understand that there is always a dearth of competent gas-fitters; and any schemes of technical training likely to improve the general efficiency are, therefore, most desirable. A conference has been held between the Council's officers and representatives of the Institution of Gas Engineers; and we have had before us the views of the Advisory Committees and governing bodies of various Institutions interested in the matter. Detailed proposals for classes in gas-fitting for both junior and senior students will be considered in connection with the arrangements for the session 1915-16."

Introductory.

The total number of males employed in the industry in England and Wales is 73,547. Their classification according to age and type of work is given in the following table:

—	Under 18 Years of Age.	Over 18 Years of Age.
Engaged in gas works, distribution, and public services—		
Wage earners	1,796	63,161
Salaried persons	332	6,692
Engaged in tar distillation and ammonia works—		
Wage earners	47	1,471
Salaried persons	—	48
Total	2,175	71,372

In recent years the gas undertakings have pursued a forward policy in the matter of gas supply; and they have taken the work of installation on the consumers' premises largely into their own hands. As an outcome of this policy, the undertakings are beginning to feel the need of well-trained artizans to carry out the work of gas supply, and also of a better class of man with good technical knowledge who can be entrusted with the work of negotiating with consumers and advising as to their technical requirements. In this connection, the Gas Light and Coke Company, in co-operation with the London County Council, established in 1908 a scheme for the training of their apprentices. The successful operation of this scheme has led other companies to move in the same direction.

The industry is a well-organized one; the technical side being represented by the Institution of Gas Engineers and the Society of British Gas Industries, and the commercial side by the British Commercial Gas Association. There are also fifteen Provincial Gas Associations in Great Britain and Ireland, together with six Junior Associations.

Gas Undertakings in the Administrative County of London.

There are in all 35 companies which supply gas under statutory powers in the area known as "Greater London." The County of London is supplied with gas mainly by three Companies, known as the "Metropolitan Gas Companies." These Companies also supply areas outside the county. The three Companies are the Gas Light and Coke Company, the South Metropolitan Gas Company, and the Commercial Gas Company. Other Companies supplying in the County of London are the Brentford Gas Company, the Wandsworth, Wimbledon, and Epsom Gas Company, and the South Surburban Gas Company.

Gas Light and Coke Company.—Total area of supply, 125 square miles; approximate area of supply in the County of London, 43 square miles, comprising Hammersmith (northern part), Fulham, Battersea (northern part), Kensington, Chelsea, Paddington, Westminster, Lambeth (northern part), Hampstead, St. Marylebone, St. Pancras, Holborn, City of London, Finsbury, Islington, Stoke Newington, Hackney, Shoreditch, Bethnal Green (except a small part in the south-west).

South Metropolitan Gas Company.—Total area of supply, 51·5 square miles; approximate area of supply in the County of London, 50·5 square miles, comprising Battersea (southern part), Clapham, Streatham (except a small part in the south-west), Lambeth (main part), Southwark (except a small part in the west), Camberwell (main part), Lewisham (eastern part), Deptford, Greenwich, Woolwich.

Commercial Gas Company.—Total area of supply, 7 square miles; approximate area of supply in the County of London, 6·5 square miles, comprising Stepney, Poplar, and small portions of Bethnal Green, Shoreditch, and Hackney.

Wandsworth, Wimbledon, and Epsom Gas Company.—Total area of supply, 41·5 square miles; approximate area of supply in the County of London, 7·5 square miles, comprising Putney (eastern half) and the old parish of Wandsworth.

South Suburban Gas Company.—Total area of supply, 98·5 square miles; approximate area of supply in the County of London, 5 square miles, comprising the western half of Lewisham and small parts of Camberwell (south) and Lambeth (south-east).

Brentford Gas Company.—Total area of supply, 49 square miles; approximate area of supply in the County of London, 4 square miles, comprising Hammersmith (main part), Putney (western part), and Fulham (a very small part in the north).

Existing Provision for Technical Instruction in Subjects Connected with the Gas Industry in the County of London.

There are six Institutions in London in which instruction is given in evening classes in subjects connected with the gas industry, and one Institution in which part-time day and evening courses are held for the training of gas-fitter apprentices. No clear distinction at present exists between the subject-matter of the classes in "Gas Engineering" and "Gas Manufacture;" and the classes in "Gas Supply" and "Gas Fitting" are practically identical so far as the practical work is concerned. Part-time day and evening courses, extending over six years, are held at the Westminster Technical Institute, for apprentices of the Gas Light and Coke Company.

Extent to which use is made of the existing Provision for Technical Instruction.

Number of Employees of Various Grades in the Gas Industry in London.—The total number of men employed by the Gas Light and Coke Company, the South Metropolitan Gas Company, the Commercial Gas Company, the Wandsworth, Wimbledon, and Epsom Gas Company, the Brentford Gas Company, and the South Suburban Gas Company is 25,872. It has not been found possible for the purpose of this report to determine the number of the men in the employ of these undertakings engaged in work within the Administrative County of London; but the following table gives an analysis of the various types of work and the total number of men employed in each grade by the six undertakings mentioned above.

Type of Work.	Number of Men Employed.
Works Department:—	
Engineers and assistants	99
Chemists	103
Draughtsmen	43
Foremen	390
Mechanics	3,225
Unskilled and low-skilled men (including stokers)	10,299
Learners and apprentices	105
Total for Works Department	14,264
Distribution Department:	
Inspectors	443
Foremen	382
Fitters and Mechanics	3,406
*Unskilled and low-skilled men	2,400
Learners and apprentices	483
†Public service men	1,956
Total for Distribution Department	9,070
‡Clerical Staff (all departments)	2,538

* Some undertakings employ contractors for mainlaying—such labour is not included.
† Includes lamplighters and maintenance men.
‡ Includes collectors.

Courses of Training for Employees of Various Grades.—In the table given below, the various grades of employment are grouped under four heads. For each group the total number of employees is given, and the type of training available in London at the present time is indicated. The number of Institutions in which the instruction is given and the number of individual students attending classes in which the instruction given bears directly upon the gas industry are also shown.

Group.	Grade and Type of Employment.	Number of Employees.	Course of Training.	Number of Institutions in which Instruction is given.	Number of Individual Students.
A	Managers, engineers, chemists, heads of departments, draughtsmen	245	(i) Full-time course at University or Technical College	9	..
			(ii) Evening classes in Gas Manufacture and Engineering	2	91
B	(i) Learners and apprentices	588	(i) (*a*) Part-time day and evening courses	1	110
	(ii) Foremen, mechanics, gas fitters, public service men, and inspectors	9,802	(*b*) Evening classes in Gas Fitting	2	80
			(ii) Evening classes in Gas Supply	3	392
C	Unskilled and low-skilled men	12,699	Evening classes in L.C.C. non-vocational Institutes	11	..
D	Clerical staff	2,538	Evening courses in L.C.C. Commercial Institutes	25	..

The number of students connected with Group A undertaking a full-time course of training before entering the gas industry is probably a very small one. A considerable number of persons in Group B probably attend evening classes in mechanical engineering subjects in the various Polytechnics and Technical Institutes in London. These attendances are not included in the statistics given. In a similar manner, a considerable number of employees in Group D are probably attending courses in Commercial Institutes. There is no evidence to show that

persons employed in Group C are attending non-vocational classes to any considerable extent.

REPORTS ON EXISTING CLASSES AND COURSES.

Battersea Polytechnic.—Provision is made in the prospectus issued by the Polytechnic for lecture classes in gas supply, grade I. and final; and it is stated that a practical class will be formed in connection with these if sufficient students should make application for it. Of these classes, the lecture class of Grade I. is the only one that has been held during the current session. It is attended by six students, all of whom are connected with the gas industry.

Goldsmiths' College.—Classes are held in gas supply, Grade I. and final, and grouped courses have also been arranged in this subject extending over two years, as follows: First Year.—Practical mathematics, machine drawing, gas supply (Grade I.). Second Year.—Practical mathematics, building construction, gas supply (final). The number of students enrolled in the class for gas supply (Grade I.) is nineteen, of whom eleven are taking the grouped course of the first year. The number of students in the final class in gas supply is 3, all of whom are taking the grouped course of the second year. The age range of the students is 17 to 33, and the average age is 22. The students reside in the districts in the vicinity of the College. All are connected with the gas industry.

Polytechnic, Regent Street.—Classes in gas engineering have been held at the Regent Street Polytechnic since 1888. During the past five years the chemical aspect of the subject has been developed, and now forms part of the work in the higher classes. Classes are held in gas engineering and manufacture, Grade I. and final, and in the chemistry of gas manufacture, as an adjunct to the final class in gas manufacture. The number of students enrolled is: Gas engineering and manufacture (Grade I.), 35; gas engineering and manufacture (final), 23; chemistry of gas manufacture, 24. The students, with few exceptions, are directly connected with the gas industry. In the class of Grade I., the lowest age is 17 years; and one-third of the students are 25 years of age and upwards. In the class for the final examination, the lowest age is 18 years; and rather more than one-third of the students are 25 years of age and upwards.

Westminster Technical Institute.—The classes in gas supply and manufacture are organized in two main sections: (*a*) Part-time day and evening courses for the gas-fitter apprentices of the Gas Light and Coke Company. (*b*) Evening classes in gas supply, gas engineering, and gas manufacture for students other than those attending under the Gas Light and Coke Company's scheme.

The part-time day and evening courses for the gas-fitter apprentices of the Gas Light and Coke Company were established in 1908 by the Gas Light and Coke Company in co-operation with the London County Council. Their object is to afford a graduated course of training for apprentices in the employ of the Gas Light and Coke Company. The theoretical portion of the training, together with special instruction in gas supply, is carried out in part-time day classes and in evening classes held at the Westminster Technical Institute. The practical training is carried out on the Gas Company's premises in Horseferry Road, in workshops which have been specially equipped for the purpose. The course of training extends over a period of six years. The total number of students in attendance at these courses at the present time is 110.

The Gas Light and Coke Company take into their service for training about twelve lads every six months. Applications for entry to the course are invited by the London County Council from pupils attending public elementary schools in the district; and these applications are submitted to the Gas Company. Applications are made also direct to the Gas Light and Coke Company by sons or relatives of the employees of the Company. The age-range of the students is from 14 to 20 years. The Gas Company pay wages to the lads in training at the rate of from 2s. 6d. per week in the first year to 22s. 6d. per week in the final year of their apprenticeship.

The work done at the Westminster Technical Institute throughout the course averages 5½ hours per week for about 40 weeks per annum. It includes instruction in technical calculations, technical drawing, English, elementary mechanics and physics, and gas supply. The courses of instruction are as follows:—

First Year.—Attendance for three afternoons (9 hours) each week at classes for technical calculations, drawing, and English.

Second Year.—Attendance for one whole day (6½ hours) each week at classes for technical calculations, elementary mechanics and physics, and English.

Third and Fourth Years.—Attendance for two evenings a week (4½ hours) at classes for gas supply and English, and at a short course on the wiping of lead joints. The latter course is held in the day time, and involves attendance for 44 hours per week for seven weeks.

Fifth and Sixth Years.—Attendance for two evenings a week for more advanced work in gas supply and English.

The classes held in the daytime are restricted entirely to apprentices in the service of the Gas Light and Coke Company; but those held in the evening are open to all comers.

The curriculum followed in the day classes is a well balanced one, and is suited to the requirements of the lads. Excellent work was seen in technical calculations and drawing; but the instruction in physics and mechanics requires strengthening. Care should be taken to see that the lads understand clearly the fundamental principles which the experiments that they perform are designed to illustrate; and more responsibility should be placed upon the boys than is the case at present in connection with the arrangement and performance of the experiments.

The instruction in joint wiping is in the hands of a qualified plumber; and excellent work is done by the students. Some simple instruction in the characteristic properties of the various metals used in the workshop, and some explanation of the principles underlying the processes

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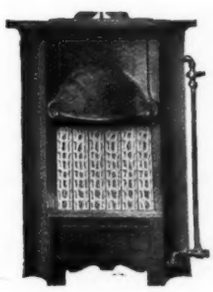

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employed, might be added with advantage. The workshop is well furnished with tools and appliances, which have been supplied by the Gas Light and Coke Company. Special attention is paid to the teaching of English throughout the course, and an attempt is made not only to give to the lads a command of their mother tongue, but to foster in them a love of good literature, and to instruct them in the duties and rights of citizenship.

The training in practical work, which is carried out in the workshop in Horseferry Road, and in connection with installation and repair work in the district, is apportioned as follows: Twelve months in training workshop for 36 hours per week; eighteen months on gas work in the district as assistants to fitters; twelve months as fitters' mates; six months meter testing; six months mantle maintenance; six months as fitters; six months in show-room; three months in offices; three months estimating.

The training workshops at Horseferry Road comprise a store-room, polishing and lacquering shops, brass and tin shop, general training shop, and carpenter's shop.

The scheme of the Gas Light and Coke Company for the training of their apprentices is probably the most complete of its kind in the United Kingdom, and affords a notable example of the beneficial results obtainable by wise co-operation between a great industrial concern and the local education authority. All concerned are to be congratulated on the important results already achieved and on the promise of development in the future. In considering the line of future development, it may be well to have regard to the principle of selective rejection of students at definite stages throughout the course, as may be shown to be necessary by the examination results and reports of the school authorities and the reports of the foremen and officials at the works.

As to the evening classes in gas supply and manufacture, these are held in gas supply for two grades of examination. An intermediate course has also been arranged for students who have already given some attention to the subject of gas supply, but who are not sufficiently advanced to profit by attendance at the senior class. Classes are held also in gas manufacture and gas engineering; and special courses consisting of three lectures on refractory materials and gaseous combustion have been given during the current session by experts.

As stated previously, the apprentices of the Gas Light and Coke Company attend the evening classes in gas supply as part of their course of training; figures for the attendance of these apprentices are not included in the statistics given below. The total number of enrolments for the classes in gas supply, manufacture, and engineering for the current session is 481. The age-range of the students is from 15 to 21 years and upwards; the majority of the students being over 20 years of age. Except in a few instances, the students are employed in the gas industry. A class in technical calculations and drawing is held in connection with the classes in gas supply and gas manufacture, and is attended by 58 students out of a total enrolment of 294 students in the classes for gas supply and manufacture.

The instruction in gas supply, Grade I., consists of a lecture and class work of 2¼ hours' duration on one evening; a second evening being devoted to workshop practice. The lecture is attended by 281 students, of whom 100 attend also the class for workshop instruction. The lecture classes are held in two sections; but even when divided in this way, they are too large to allow satisfactorily of informal discussions and the interchange of question and answer taking place in class. The gas supply class of intermediate grade is attended by 11 students, who devote 2¼ hours on one evening per week to class work and laboratory work in gas supply. The instruction in gas supply, Grade II., consists of a lecture and class work of 2¼ hours' duration. The class is attended by 71 students. A second evening per week is devoted to a class in laboratory work, which is attended by 27 students. The laboratory class is intended specially for students who have already passed the final examination in gas supply. The experiments undertaken in this class are of an advanced nature; but the students for the most part are not well prepared to carry them out, owing to their lack of preliminary training in experimental science. Considerable additional laboratory accommodation is needed, if the work is to be placed on a sound footing.

The class in gas manufacture is attended by 13 students. It is associated with a short course in gas engineering, which consists in part of lectures and in part of laboratory work. There are 20 enrolments for the short course.

London County Council School of Building, Brixton.—Evening classes are held, at the Brixton School of Building, for gas-fitter apprentices employed by the South Metropolitan Gas Company. Classes of two hours' duration are held on three evenings a week throughout the session in workshop arithmetic, iron pipe work (workshop), and elementary building construction and drawing. The total number of students in attendance at the course is 60. They are divided into three sections of 20 each for work in the class-rooms and workshop. The workshop has been well equipped with apparatus by the South Metropolitan Gas Company, and some experimental apparatus has been erected by the students.

The classes were started only at the commencement of the current session, and are evidently meeting a need of the locality. It is hoped that in the future these classes may develop into a part-time day course for gas-fitter apprentices, similar to that at the Westminster Technical Institute.

South Grove Junior Technical Institute, Stepney.—Evening classes in gas-fitting were started at this Institute in November last. The classes are attended by 20 students; and the age-range is from 14 to 18 years—the average being 15·7 years. The classes are held on three evenings a week throughout the session, and instruction is given in English, trade workshop, trade lecture and calculations, and gymnastics.

General Observations and Suggestions.

Influence of External Examinations upon the Teaching.—A consideration of the reports on the individual schools shows that the teaching in

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connection with the gas industry in London is very largely influenced by the system of external examinations at present in vogue.

There is no doubt that this system of external examinations presents certain advantages. It secures uniformity of syllabus and of aim in detached classes; and by the issue of certificates of various grades, it provides a stimulus to the students and to the teachers in their work, and affords a basis upon which some recognition of training can be made by employers.

On the other hand, any system of purely external examination is liable to grave abuse. The passing of the examination is almost invariably made the aim of the instruction; and the teaching throughout the course is distorted by this consideration. The external examination in gas subjects can be passed most easily upon work of a descriptive character, and, in consequence, an undue emphasis is placed in the teaching upon a knowledge of things, to the neglect of a knowledge of principles and skill in thinking. This neglect of fundamental principles is further accentuated by the fact that the examinations in connection with the gas industry are restricted to the trade subject, and satisfactory attendance and work in classes in related science subjects is not required.

The following suggestions are made with a view to indicating the lines upon which improvement may be effected:

(*a*) The formation of "grouped courses," involving instruction in the trade subject and in the science subjects related to it. Distinct courses should be formed to meet the requirements of various grades of students.

(*b*) The establishment of internal examinations in the individual schools. The examinations to be conducted by the teachers concerned, in conjunction with one or more external assessors who would act for the whole of London.

(*c*) The issue of awards and certificates based upon—

(i) The results of the examinations;

(ii) The results of the home work, class work, and practical work done during the session;

(iii) Reports by foremen and employers on conduct and progress in the workshop or office.

The establishment of a scheme of internal examinations on these lines would conserve the advantages already enumerated in connection with the existing system of external examinations, and would at the same time greatly increase the efficiency of the teaching.

Suggested Training for Gas-Fitter Apprentices.—The following alternative methods of training gas-fitter apprentices may be considered:

(*a*) Part-time day and evening courses of instruction extending over five or six years held in a Technical Institute, with special instruction in practical work given in the works during the period of apprenticeship.

(*b*) Full-time attendance for a period of two years at a day course in engineering at a Junior Technical School, prior to apprenticeship, followed by a period of apprenticeship for four years, during which special instruction would be given in practical work on the works.

(*c*) Attendance at grouped courses of instruction in evening classes extending over a period of two years during the period of apprenticeship, with concurrent instruction in practical work given on the works.

Part-Time Day and Evening Courses.—In addition to the Westminster Technical Institute, where a scheme of this type is already in operation, there would appear to be need for a centre of instruction in the North or East of London, and for one in the South-Eastern district. Attendance at the course should be made contingent on the satisfactory progress of the student from year to year, as judged by the reports of the school authorities and of the works officials.

Full-time Day Training at a Junior Technical School.—Of the three alternatives presented, this scheme would probably yield the best results. There are already established in various parts of London seven Junior Technical Schools giving a general training in engineering suited to the needs of students who will ultimately become skilled workmen. All that is needed, therefore, to put this scheme into operation would be co-operation between the gas companies and the school authorities to regulate the number of students in training who are desirous of entering the gas industry, and the establishment of definite courses of training in practical work during the period of apprenticeship.

Grouped Courses of Instruction in Evening Classes.—This method of training is the least satisfactory of the three methods referred to, owing to the limited time available for the purpose of instruction, and the adverse condition under which the instruction is given. The courses should extend over three nights per week, and instruction should be given in trade methods and calculations, workshop drawing, and workshop practice. The results obtained in the evening courses might well be used for selecting students for subsequent attendance at part-time day courses.

Suggested Training in Gas Engineering and Manufacture.—For young men intending to make gas engineering their profession, a full-time day course in the engineering faculty of one of the Universities, or in one of the larger Technical Colleges, is desirable. Ample facilities exist in London and elsewhere for full-time courses of this character. For students who are not able to undertake a full-time course of training, part-time day courses or evening courses should be arranged extending over four or five years. The evening courses should take the form of grouped courses held on three nights a week, and should include ample provision for instruction in mathematics, physics, chemistry, and engineering drawing, in addition to instruction of a technical character relating to the gas industry. Throughout the course an intimate relationship should be maintained between lecture and laboratory work, and as much emphasis as possible should be placed upon instruction in the laboratory. A system of certificates in connection with internal examinations should be established for these courses.

Organization for Future Developments.—Up to the present time, the

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part-time day courses and evening courses relating to the gas industry in London have been established by the co-operation of individual gas undertakings with the local education authority or with the authorities of individual schools. These courses have been developed successfully; and a point has now been reached where the requirements of the gas industry in London in relation to the educational facilities of the country should be considered as a whole. It would appear to be desirable, therefore, that some representative body—such as the Institution of Gas Engineers—should co-operate with the local education authority for London in the provision of effective training for employees in the gas industry of the Metropolis.

NOTES FROM SCOTLAND.

Cheapest Gas in Scotland.—In sending an intimation that, as from the 1st inst., the price of gas in Coatbridge "to all classes of consumers" will be reduced by 3d. per 1000 cubic feet, the Interim Secretary and Treasurer of the Coatbridge Gas Company (Mr. David Lambie) writes that this will make the charge for lighting 2s. per 1000 cubic feet, "which is considerably cheaper than the rate charged by any other undertaking in Scotland."

Public Electric Lighting at Hawick.—The public electric lighting at Hawick is evidently far from all it might be. At a recent meeting of the Town Council, the Town Clerk reported that he had been instructed to write to the Urban Electric Company about the defective street lighting; and he read a letter in reply, regretting the complaints, but pointing out that the nature of the complaints was not mentioned. One member remarked that there were nothing but complaints; and another said that the light of the lamps just made darkness visible.

Economizing in Edinburgh.—The City Chamberlain of Edinburgh (Mr. Robert Paton) has issued a report on the reductions which are being effected in the city's expenditure, and on the possible changes in administration which may be submitted for the consideration of the Town Council, with a view to ascertain what permanent economies may be carried out after the war is ended. In his introduction, he points out that the total number of employees who have gone on war service up to date is 830. At the present time, the total member of employees in the service, including temporary men, is 1842, as compared with a total authorized strength of 2491. Considerable reduction is being effected in the cost of lighting, and in the cleansing department. There is, he says, room for the permanent curtailment of expenditure under the heading of public lighting. The restricted lighting last winter demonstrated how small the actual minimum necessities of the city are. The over-illumination of pre-war days arose from the fact that the old flat-flame burner was replaced by the incandescent mantle—that is, 45-candle power was substituted for about 5-candle power—while the distances between the lamp-posts remained the same. In the case of most of the streets, it will be found that one-half the number of lamps will provide a sufficient measure of lighting. This would represent a saving of about £7500 per annum in wages and in gas consumed. A further saving may be effected by a system of automatic lighting. The restricted lighting by electricity both last winter and this winter has shown that there is also room for reduction of the expenditure under this head. From £1500 to £2000 per annum could be saved in this way. The substitution of gas or electricity for coal, in the matter of heating the various properties of the Corporation, is suggested as worthy of consideration.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Jan.* 3.

The market for tar products is quiet, and there is nothing of particular interest to record. From time to time, boats of one description or another are found, so that shipments of pitch continue, if somewhat slowly. The present values range from 19s. to 19s. 6d. per ton net, at makers' works. Other values are: Creosote, 4⅛d. to 4¼d. per gallon, in bulk; 90-160 solvent naphtha, 2s. 2d. per gallon, naked; 48-50 per cent. anthracene, 2½d. per unit, casks free; 60's crude carbolic, 3s. 4d. per gallon, naked; pure toluol, 3s. 4½d. per gallon, naked—all at makers' works, net cash.

The demand for sulphate of ammonia continues good, and values are very firm—£17 5s. per ton net, into buyers' bags, at makers' works, is reported as having been paid for 25 per cent. quality down to June next.

Tar Products in the Provinces.

Jan. 3.

The markets for tar products remain about the same. There is nothing fresh to report concerning pitch. Offers are still being made at reasonable prices; but the difficulty in securing freights prevents the concluding of the transaction. Creosote is very quiet, and shows no signs of improvement. Heavy and light naphthas are in good demand.

The average values of gas-works products during the past week were: Gas-works coal tar, 18s. 6d. to 22s. 6d. Pitch, East Coast, 15s. 6d. to 16s. 6d. per ton; West Coast, 15s. to 15s. 6d. Manchester; 16s. to 16s. 6d. Liverpool; 17s. to 18s. Clyde. Benzol, 90 per cent., North, 10½d. to 11½d.; 50-90 per cent., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha, in bulk, North, 6½d. to 7d. Solvent naphtha, naked, North, 2s. to 2s. 1d. Heavy naphtha, naked, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, 2⅞d. to 2⅞d. Heavy oils, in bulk, 3⅛d. to 4d. Carbolic acid, 60 per cent., East and West Coasts, 3s. 5d. naked. Naphthalene,

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Cleaning—disconnect two unions only to remove whole of inner chambers.

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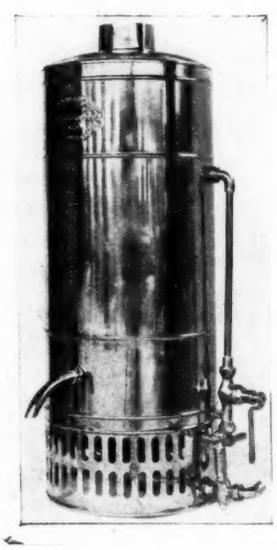

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Sulphate of Ammonia in the Provinces.

LIVERPOOL, *Jan.* 1.

Notwithstanding the intervention of the holidays, the strength of the market has been well sustained during the past week, and a further advance in values has taken place. The volume of foreign business has not been large; but there has been good demand for home consumption for agricultural purposes as well as for munitions. To-day's quotations for prompt delivery are £17 10s. per ton f.o.b. Hull, £17 16s. 3d. f.o.b Liverpool, and £18 f.o.b. Leith. Few transactions have been reported in the forward position this week, but it has transpired that £18 per ton f.o.b. Liverpool has been paid for January-March, and £17 15s. for April-June delivery.

Manchester Tar Prices.

The average price realized for tar—based on the value of the products—for November deliveries, in the Manchester district, was 25s.

Nitrate of Soda.

The market for this material is quiet but steady at 15s. 3d. per cwt. for ordinary quality, and 16s. 3d. for refined, on spot.

Sulphate of Ammonia.

From another source, it is stated that higher prices are still being paid for this article. London makes are reported to have been sold at £17; Hull, £17 10s.; Liverpool, £17 15s. to £17 17s. 6d.; Leith, £17 17s. 6d.; Middlesbrough, £17 15s. to £17 17s. 6d.

COAL TRADE REPORT.

Northern Coal Trade.

The northern coal trade is influenced by the reduced production owing to the holidays, and the fact that this limited output is needed for the current contracts. There is very little steam coal available for prompt shipment, and thus the prices that are quoted are nominal, unless it be for small quantities. For best Northumbrian steams, from 22s. to 24s. is quoted; but probably lower prices will rule as the production grows normal. Second-class steams are about 20s. per ton; and steam smalls vary from 10s. to 13s. per ton—all f.o.b. There are fair arrivals of steamers at the coal ports. As work becomes full at the pits, there should be heavier shipments, and possibly prices more like those that prevailed until just before the holidays. In the gas coal trade, the demand is very heavy; and the long contracts take up most of the production, which is also affected by the slow return to work of the miners. Best Durham gas coals are about 21s. to 21s. 6d. per ton f.o.b. for early delivery; second-class gas coals are 19s. to 19s. 6d. per ton; and "Wear Specials" are 22s. to 22s. 6d. per ton f.o.b. Nothing is doing in contracts just at present. But the fixing of the maximum price for coke for home consumption may have some influence on the coal trade of Durham, which produces coking coal largely, and possibly it may tend to limit the use of coal at some of the ovens. Gas coal must, however, be looked on as beginning to near the time when consumption at home will commence to decrease; but how the stocks generally compare with those usually held at this season is not known with any certainty. Freights are still high—gas coal from the Tyne to London being about 15s. 6d. Coke is influenced by the introduction of maximum prices in some cases; but gas coke is not much altered. Good export gas coke may be quoted at 28s. to 29s. per ton f.o.b. on the Tyne. Stocks of gas coke are not very heavy generally.

Income-Tax on Earnings of All Undertakings.

Mr. H. Ross Clyne, a member of the Manchester Corporation Gas Committee, has tabled the following notice of motion, which he intends to bring forward at to-morrow (Wednesday's) meeting of the City Council: "That, in the opinion of this Council, the Government should forthwith impose a direct income-tax without rebate on the net earnings of all undertakings of whatever nature or constitution—each undertaking to be treated as a separate unit." The question of disposing of a portion of the surplus profits of trading departments of the Corporation is expected to be raised by Mr. James Johnston, who is to move that a Special Committee, of the Chairman of the Gas, Water, Improvements, and Buildings, Sanitary, and other Committees, be appointed, for the purpose of considering the advisability of placing at the disposal of the Local Government Board the surplus land of the Corporation for house-building purposes, and of endeavouring to obtain their assistance in financing a scheme of housing on such land to meet the grave shortage of housing accommodation in Manchester; also to consider the desirability of applying a portion of the surplus profits of the trading departments of the Corporation for housing purposes, instead of borrowing new capital; and to present to the Council a report at as early a date as possible.

Gas-Works Extensions at Devonport.—The Plymouth Corporation Gas Committee have, it is reported, decided to instruct their Consulting Engineer (Mr. Isaac Carr) to prepare plans and specifications for increasing the capacity of the gas plant at the works at Devonport to meet the growing requirements. The Gas Engineer, Mr. W. P. Tervet, reported that the consumption of gas on Christmas Eve was a record one; amounting to 2,106,000 cubic feet, as against 1,980,000 cubic feet in the previous year.

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Ripon Gas Troubles.

The Ripon Gas Committee have issued a statement in reference to the trouble in maintaining the supply of gas, as already recorded in our pages. They state that the entire plant has been taxed to its utmost, and all reserve generating apparatus has been called into use. Yet, with all resources working at the full, the gas supply to the city has reluctantly been restricted. The labour problem, too, has become most acute; and it has been necessary to call in the assistance of amateur workers in order to keep the city lighted. After full consideration, the Corporation deem it imperative that some immediate steps be taken to augment the existing gas-making plant, in order to secure for the consumers an adequate supply of uniform-quality gas. To attain this end, it is proposed to adopt the most up-to-date methods, embodying every facility for manufacturing high-quality gas on the most economical lines, having due regard to efficiency in every respect. They further hope, by this improved method of production, to reduce the price of gas to the consumer. The statement adds that it is hoped, on account of its urgency and absolute necessity, to obtain the sanction of the Local Government Board to this substantial extension.

Gas Fatality at Blackpool.—A man named Albert Crowther, 70 years of age, died from gas poisoning at Blackpool on Christmas Day. It is supposed that he had occasion to light the gas during the preceding night, and in putting it out accidentally turned the tap on again. At any rate, he was found unconscious in bed, with the unlighted gas turned full on.

Soldiers and Gas Cooking.—It seems that over 10,000 soldiers quartered in Toronto have their meals prepared in kitchens equipped with gas-ranges and gas water-heaters; and daily readings of the meters show that the gas consumed is costing the military authorities less than one-half a cent per day per man. Double oven stoves are used, with four top burners on each oven; and it is found that eight of these double ranges are sufficient to cook for a battalion, consisting of approximately 1200 men. Altogether there are over a hundred of the ranges in use. To supply the camps, it has been necessary for the Toronto Consumers' Gas Company to lay a new main nearly 1500 feet in length.

Second Advance at Stourbridge.—A second advance in the price of gas since the beginning of the war has been agreed to by the Stourbridge Town Council. The Gas Committee recommended that the price of gas for power supply be raised 2d. per 1000 cubic feet, and for lighting purposes 1d., as from the reading of the ordinary meters for the Christmas quarter. Mr. Keeble moved that the recommendation be deleted; but the amendment was not seconded. Alderman Fiddian, in moving the adoption of the report, said the previous advance was 2d. per 1000 cubic feet for power, and 3d. for lighting. It was not proposed to increase the price to slot-meter users. The recommendation was adopted.

Gas-Mantles in America.

In the course of an article entitled a "New Industry Born of War—Gas-Mantles," the "Chicago Daily News" points out that seventeen months after the outbreak of war, America is still abundantly supplied with incandescent mantles; and the fact marks the birth of the new American thorium industry. It was war that permitted the emergence of the American industrial chemists from under the shadow of the mighty accomplishments of Germany. Under the direction of Americans trained in universities and technical schools, vast sums of money have since July, 1914, been spent in experiment; and amid the varying results, the American manufacture of thorium is a conspicuous example of success. "One case," the writer of the article says, "that is typical of many is that of a Chicago firm, the Lindsay Light Company. For years before the dawn of 1914, this Company's experts had worked out the necessary procedure by means of the laboratory method. That is, the thing had been done on a small scale, with an eye to accomplishment on a greater scale whenever occasion should arise. New machinery had to be provided; and before it could be constructed, it had to be devised. This was done. Within ninety days after they had installed their new plant, the Chicago people were producing. They are now turning out enough thorium nitrate for their own needs, and exporting it to whatever port in the wide world calls for it, and the necessities of war time commerce permit its entrance. New thorium-bearing sands were discovered far away from Brazil, fresh lanes of ocean traffic were utilized, and Chicago skill was taught to duplicate all the processes that had previously been left to German brains and hands." The Lindsay Light Company (whose agents for the United Kingdom are Messrs. Paul Winn and Co., Limited) say that "every part of every Lindsay gas light and gas mantle is made in the U.S.A."

Increase in Price at Elland.—From the New Year the Elland-cum-Greetland Gas Company have decided to increase the price of gas 4d. per 1000 cubic feet, making it 2s. 10d. During last year a record amount of gas was sold by the Company, owing to the large number of factories working long hours of overtime, and some all night.

More Light for Paris Streets.—In a message dated last Wednesday, the Paris Correspondent of the "Daily Telegraph" said: Paris has never been quite as dark at night as London; and we are now to have yet a little more light. One thousand extra street lamps are to be lit, and in particular there is to be light enough at all street-crossings for safety of traffic. Experts here are sceptical about the usefulness of darkening cities against airship raids. All aviators of the Paris defence force say that, however much the lights of Paris have been put out, they could always distinguish the town without the least difficulty when flying at night. In short, they say that defence against Zeppelins depends solely on the efficiency of the aviation service, and that for Paris to darken herself is a futile ostrich policy. Therefore, General Maunoury, the Military Governor, has decided to allow more light.

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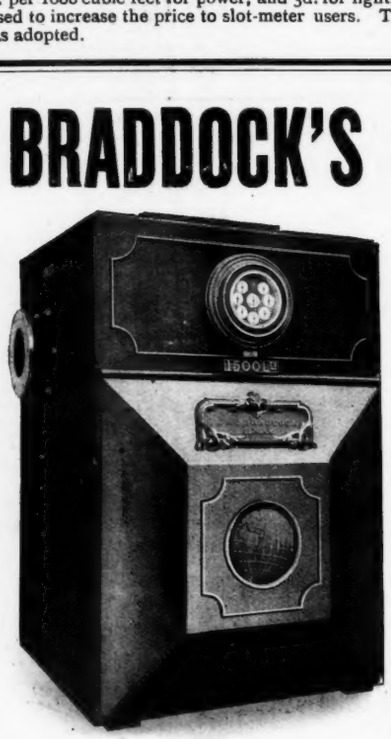

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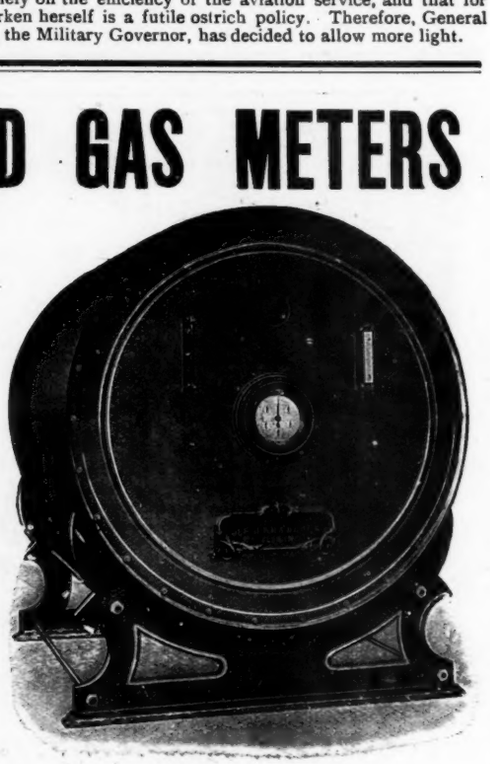

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Haywards Heath Gas Debentures and Ordinary Stock.—Readers will have noticed in the advertisement pages that Messrs. A. & W. Richards, of No. 37, Walbrook, E.C., are offering for sale by tender £3500 of 5 per cent. perpetual debenture stock and £5000 of ordinary stock in the Haywards Heath District Gas Company. The latter ranks for a standard dividend of 5 per cent., subject to the sliding-scale, and is entitled at the present selling price of gas of 4s. per 1000 cubic feet to dividend at the rate of 6⅛ per cent. per annum. In both cases the minimum price at which tenders will be considered is par.

Nottingham Lighting Restrictions.—Concurrently with the changes which have been made in the lighting administration at Nottingham, some welcome alterations have been effected in regard to street illumination, as to which there had been previously much grumbling, upon the score that the official regulations had been too rigidly interpreted. In place of haphazard daubing, which had the effect of practically obscuring the light, while the gas was burning to waste, the lamps have now for the greater part been cleaned and the glass repainted at the tops and partially at the sides, in a pinkish hue, with the result of preventing diffusion of light above, while rendering it possible for pedestrians to steer their course with a fair amount of comfort in the streets below.

Street-Box Explosions in Belfast.—A defect in the Belfast electric system led to a good deal of commotion a fortnight since. One of the inspection-box covers in Rosemary Street was blown up by an explosion, and immediately afterwards the cover of a second box close at hand was shattered by a like explosion. In both cases the gas-main was injured; and flames leapt through the openings. The gas continued to flare for almost an hour. A water-main was also burst by the force of the explosions; and the thoroughfare was flooded. The electric current was cut off as quickly as possible; and much inconvenience was caused in regard to the lighting.

Carbonizing Plant at Tipton.—The Manager of the Tipton Gas-Works (Mr. William Prince), in a report to the Council, states that the deliveries of gas show a big increase. The first two beds of retorts in the old house were got into working order by Nov. 20, and the gas made in these had enabled him to get through the subsequent large demand made on the works, due to munition requirements, fogs, &c. Though gas was supplied of a lower illuminating power than usual, he was thankful to report that he had at all times been able to meet the demand and maintain adequate pressure on the district. He proposed to submit a report to the Council later on embodying proposals for the further extension of the carbonizing plant.

STOCK MARKET REPORT.

LAST week—the closing week of the year—the Stock Exchange had another four-day period, with a holiday on the Monday and another on Saturday. But it was neither idle nor dull. Business grew in activity from day to day, and the tone, which was very fair at the opening, became brighter and brighter. Thus, on Friday, the week—and the Year of Grace 1915—terminated in conditions of activity and cheerfulness, which it may be hoped are of happy augury for the New Year. Government issues and the gilt-edged group, after some hesitation, went ahead, and War Loan and Consols were in good demand. Americans zig-zagged somewhat, owing to Wall Street operations. They dragged Canadians about with them, notwithstanding the fine show of trade and traffic apparent in the Dominion. However, they finished buoyant. Home Rails were stronger, though one or two questions looming ahead of them are not quite clear yet. In the Foreign Market, French loan and Japanese were prominent. South Africans and Argentine rails showed firmness. In the Miscellaneous group, shipping and armaments were in good demand; but the liveliest line was Rubber, the high price of the raw article causing a rush for shares. So everything went along joyously; and the House took no heed of Cabinet dissensions over supreme affairs of State. A noteworthy incident was a Treasury announcement that, upon the recommendation of the Committee on War Loans for Small Investors, 5 per cent. Exchequer Bonds of £5, £20, and £50 each will be issued, to be obtained (and deposited, if so desired) at a Post Office. At the same time, the limitations on Post Office Savings Bank deposits were relaxed. There was more talk about minimum prices, and rumours of further progress of measures to amend, and perhaps to abolish, them altogether. But as to the policy of this step, opinions differ. Business in the Gas Market was quieter than ever—not sufficient to afford any indication of a tendency to move either way. It must be borne in mind that only one in the entire list of quoted gas issues has an official minimum-price—viz., Melbourne 4½ per cent. bonds. In all the rest, bargain prices are a matter of agreement between the parties. In the Money Market, there was a good demand for the year's end, and discount rates were harder.

Bargains done for cash during the week were as follows: On Tuesday, European 12$\frac{11}{16}$, South Metropolitan 79, South Suburban 86. On Wednesday, Gas Light ordinary 71, 71½, 71¾, 72, South Metropolitan 78, 78½. On Thursday, Gas Light ordinary 70¾, 71¼, 71½, ditto maximum 60, Newcastle 80, South Metropolitan 78½. On Friday, European 13, Gas Light ordinary 70⅝, 71¼, 71½, preference 75½, Imperial Continental 80, 82, Primitiva debenture 85, 85½, South Suburban preference 90.

The Bank rate is 5 per cent.—as fixed on Aug. 8, 1914.

At a parish meeting at Pilsley, it has been unanimously decided to discontinue the public lighting for the remainder of the season as a protest against the increase of 3d. per 1000 cubic feet demanded by the Clay Cross Gas Company. It was also suggested that the gas-lamps be taken down and stored; and Mr. W. F. Clayton expressed the hope that the residents of Pilsley would not capitulate, "even if they never had the streets lit again."

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue.	Share.	When last Dividend.	Previous Div or Dividend & Bonus.	Last Dividend.	NAME.	Closing Prices, July 30, 1914.	Yield on Highest Closing Price.	Lowest and Highest Prices of Bargains.
£			p.c.				£ s. d.	
1,551,868	Stk.	April 8	2½	5⅛	Alliance & Dublin Ord.	59—64	3 18 2	..
374,000	,,	July 10	4	4	Do. 4 p.c. Deb.	76—79	5 1 8	..
280,000	5	April 29	7½	3/-	Bombay, Ltd.	5⅞—6⅜	5 17 8	..
50,000	10	Feb. 26	16	15/-	Bournemouth Gas and Water — 10 p.c.	29—30	6 6 8	..
878,480	10	,,	7	7/-	Bournemouth Gas and Water — B 7 p.c.	15—15½	4 10 4	..
95,000	10	,,	6	6/-	Bournemouth Gas and Water — Pref. 6 p.c.	13½—14	4 5 9	..
147,240	—	—	—	4	Bournemouth Gas and Water — Deb.	..	—	..
280,000	Stk.	Feb. 26	†14	56/-	Brentford Consolidated	261—266	5 5 3	..
330,000	,,	,,	†11	55/-	Do. New	204—209	5 5 3	..
50,000	,,	,,	5	5	Do. 5 p.c. Pref.	109—111	4 10 1	..
206,250	,,	June 11	4	4	Do. 4 p.c. Deb.	91—93	4 6 0	..
217,380	Stk.	Feb. 26	11	10⅜	Brighton & Hove Orig.	208—213	5 3 4	..
244,200	,,	,,	8	7⅜	Do. A Ord. Stk.	154—159	5 0 3	..
530,000	20	Mar. 26	12½	22/6	British	44—45	5 11 1	..
120,000	Stk.	June 26	4	4	Do. 4 p.c. Deb. Stk.	88—90	4 8 11	..
245,771	Stk.	June 26	4	4	Buenos Ayres 4 p.c. Deb.	85—87	4 12 0	..
100,000	10	—	—	—	Cape Town & Dis., Ltd.	1½—2½	—	..
100,000	10	—	—	4/6	Do. 4½ p.c. Pref.	4—6	—	..
100,000	Stk.	June 26	4½	4½	Do. 4½ p.c. Deb. Stk.	70—75	6 0 0	..
157,150	Stk.	Feb. 26	5	5	Chester 5 p.c. Ord.	108—110	4 10 11	..
1,513,280	Stk.	Feb. 12	5/9/4	49/4	Commercial 4 p.c. Stk.	106—108	5 1 2	..
560,000	,,	,,	5½	46/8	Do. 3½ p.c. do.	103—105	5 1 6	..
475,000	,,	June 11	3	3	Do. 3 p.c. Deb. Stk.	69½—71½	4 3 11	..
800 000	Stk.	,,	4	4	Continental Union, Ltd.	76—79	5 1 3	..
900 000	,,	,,	7	7	Do. 7 p.c. Pref.	115—118	5 18 8	..
278,400	—	—	—	11½	Croydon B and C 7 p.c.	..	—	..
492,270	Stk.	—	6	6	Derby Con. Stk.	138—125	4 16 0	..
55,000	,,	—	4	4	Do. Deb. Stk.	102—104	3 16 11	..
1,002,180	10	July 29	10	10/-	European, Ltd.	17½—18	5 11 1	12½—13
16,362,910	Stk.	Feb. 12	1/17/4	42/-	Gas Light and Coke — 4 p.c. Ord.	98—102	4 15 6	70⅜—72
2,600,000	,,	,,	3½	3½	Gas Light and Coke — 3½ p.c. max.	76—79	4 8 7	60
4,062,235	,,	,,	4	4	Gas Light and Coke — 4 p.c. Con. Pref.	96—99	4 0 10	75½
4,674,850	,,	June 11	3	3	Gas Light and Coke — 3 p.c. Con. Deb.	72½—74½	4 0 6	..
180,000	,,	,,	10	10	Gas Light and Coke — 10 p.c. Bonds	..	—	..
258,740	Stk.	Mar. 12	5	4½	Hastings & St. L. 3½ p.c.	87—89	5 12 4	..
70,000	10	April 29	11	6	Hongkong & China, Ltd.	16½—16¾	6 11 4	..
86,600	—	—	—	9½	Hornsey 7 p.c.	..	—	..
131,000	Stk.	Mar. 12	7½	7½	Ilford A and C	151—154	5 2 4	..
65,780	,,	,,	6⅜	6¼	Do. B	115—118	5 8 0	..
65,500	,,	June 26	4	4	Do. 4 p.c. Deb.	92—94	4 5 1	..
4,940,000	Stk.	May 14	9	4½	Imperial Continental	150—160	5 12 6	80—82
1,935,000	Stk.	Feb. 12	3½	3½	Do. 3½ p.c. Deb. Red.	84—86	4 1 5	..
300,242	Stk.	Mar. 12	6½	6½	Lea Bridge Ord. 5 p.c.	119—121	5 7 5	..
561,000	Stk.	Feb. 26	10		Liverpool 5 p.c. Ord. A	211—213	4 18 11	..
718,100	,,	,,	7	10	Liverpool 5 p.c. Ord. B	146—148	4 14 7	..
309,083	,,	June 26	4	4	Do. 4 p.c. Pr. Deb. Stk.	..	—	..
75,000	5	June 11	6	2/-	Malta & Mediterranean	4⅛—4⅜	6 9 9	..
250,000	100	April 1	4½	4½	Met. of Melbourne 4½ p.c. Deb.	99—101	4 9 1	..
541,920	20	May 28	4	6/-	Monte Video, Ltd.	11½—12	6 18 4	..
1,775,892	Stk.	July 29	4½	4½	Newc'tle&G'tesh'd Con.	99½—99½	4 10 6	80
529,705	Stk.	June 26	3½	3½	Do. 3½ p.c. Deb.	83—84	4 4 10	..
55,940	10	Feb. 26	7/14/0	7/8⅔	North Middlesex 7 p.c.	14—15	5 2 8	..
300,000	Stk.	May 14	8	8	Oriental, Ltd.	117—122	6 11 2	..
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd.	7⅞—7⅞	6 9 0	..
60,000	50	Feb. 26	13	65/-	Portsea, Island B	125—131	4 19 3	..
100,000	50	,,	12	60/-	Do. C	118—121	4 19 2	..
52,000	50	,,	10	—	Do. D	..	—	..
249,980	5	April 29	8	—	Primitiva Ord.	5½—6	6 13 4	..
499,960	5	June 26	5	2/6	,, 5 p.c. Pref.	4½—5	5 0 0	..
521,600	100	June 2	4	4	,, 4 p.c. Deb.	91—93	4 6 0	85—85½
—	—	—	—	4	,, ,, ,, 1911	..	—	..
346,198	Stk.	June 26	4	4	River Plate 4 p.c. Deb.	85—87	4 12 0	..
150,000	10	May 14	6	6/-	San Paulo 6 p.c. Pref.	10½—11	5 9 1	..
125,000	50	July 1	5	5	San Paulo 5 p.c. Deb.	47—49	5 2 0	..
135,000	Stk.	Mar. 12	10	10	Sheffield A	233—234	4 9 3	..
209,984	,,	,,	10	10	Do. B	232—234	4 9 3	..
533,500	,,	,,	10	10	Do. C	230—232	4 10 1	..
90,000	10	May 28	9	6 -	South African	10½—11½	7 16 6	..
6,429,896	Stk.	Feb. 12	5/4,0	44/-	South Met., 4 p.c. Ord.	111—113	4 16 8	78—79
1,895,445	,,	July 10	3	3	Do. 3 p.c. Deb.	72½—74½	4 0 6	..
209,820	Stk.	Feb. 26	8½	8½	South Shields Con. Stk.	157—159	5 6 11	..
952,795	Stk.	Feb. 26	6	48/4	S'th Suburb'n Ord. 5 p.c.	114—116	5 3 5	86
60,000	,,	,,	5	5	Do. 5 p.c. Pref.	110—112	4 9 3	90
135,000	—	—	—	48/4	Do. West Kent.	..	—	..
187,058	,,	June 26	5	5	Do. 5 p.c. Deb. Stk.	116—118	4 4 9	..
629,740	Stk.	May 14	5	5	Southampton Ord.	99—102	4 18 0	..
120,000	Stk.	Feb. 12	7½	7½	Tottenham District — A 5 p.c.	135—138	5 8 8	..
742,275	,,	,,	6	6	Tottenham District — B 3½ p.c.	115—117	5 2 7	..
181,255	,,	June 26	4	4	Tottenham District — 4 p.c. Deb.	87—89	4 9 11	..
182,380	10	Dec. 30	5	—	Tuscan, Ltd.	5—6	8 6 8	..
149,900	10	July 1	5	5	Do. 5 p.c. Deb. Red.	93—95	5 5 3	..
236,476	Stk.	Mar. 12	5	5	Tynemouth, 5 p.c. max.	108½—109½	4 11 4	..
					Wandsworth, Wimbledon, and Epsom—			
80,000	Stk.	Feb. 26	8⅜	78/9	Wandsworth A 5 p.c.	151—155	5 7 4	..
255,536	,,	,,	6⅜	63/9	,, B 3½ p.c.	129—134	5 2 7	..
108,075	,,	,,	5/17/8	55/1½	,, C 3½ p.c.	110—115	5 3 0	..
352,000	,,	,,	6⅜	57/6	Wimbledon 5 p.c.	117—122	5 0 5	..
98,000	,,	,,	6⅜	63/9	Epsom 5 p.c.	121—126	5 5 2	..
88,416	,,	June 26	3	3	3 p.c. Deb. Stk.	65—69	4 6 11	..

† Paid on Old 10 p.c. and 7 p.c. Standard Stocks.

The Guiseley District Council have decided to try automatic street lighting apparatus to the extent of purchasing 80 "Gunfire" automatic street lighting controllers.

The Twickenham Lighting Committee consider it undesirable that the testing of the gas for calorific power should be discontinued, and have given instructions for the results of such tests to be reported for Committee purposes only.

The 1st of January was the 17th anniversary of the taking over by the Morley Corporation of the gas-works of the Morley and Churwell Gas Companies, at a total cost of £128,000. During the past year, nearly £10,000 has been spent in remodelling the plant, particularly in the installation of the vertical retort system.

In the course of the discussion in the French Chamber on a Bill relating to the sale and distribution of coal, M. Roden (President of the Mines Committee) pointed out that two milliards of francs annually went from France to England, and appealed to English shippers to reduce the cost of freight. He advocated still closer relations with those on this side who understood and facilitated coal transactions.

According to the "South Wales Daily News," in arranging new coal contracts with local authorities, some contractors are inserting a clause which will enable them to terminate the contracts at a week's notice if they find it impossible to deliver the coal because of further enlistments of their men.

At an inquest held at Greenwich on the body of James Cardoe, a driver in the Army Service Corps, it was stated that during the gale on Monday night of last week, some electric wires used for lighting the huts at Blackheath blew down. Deceased appeared to have fallen among the wires, with the result that he was electrocuted. A verdict of "Accidental death" was returned.

We have received from Messrs. W. G. Beaumont and Son, the painting contractors, of Priory Works, Bow, E., a copy of their Year Book and Diary for 1916. On the gas manager's desk, this book will prove a useful reminder, in more ways than one. There has also come to hand a dainty pocket diary from the Torbay Paint Company; and a date-stand from Mr. A. C. Scrivener, the Birmingham representative of the Wigan Coal and Iron Company.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

GAS AND WATER ENGINEER. Mansfield Corporation. Applications by Jan. 18.
OUTDOOR SUPERINTENDENT. Cheltenham Gas Company. Applications by Jan. 15.
CLERK. No. 6132.
GENERAL WORKING FOREMAN. Ascot Gas and Electricity Company.
MECHANIC. Stretford Gas-Works.
WORKS MECHANIC. No. 6130.
YARDMAN. King's Lynn Gas-Works.
STOKER. King's Lynn Gas-Works.

Plant, &c. (Second Hand), for Sale.

COOKERS. No. 6131.
RETORT BENCH FITTINGS. Ilford Gas Company.

Plant, &c. (Second Hand), Wanted.

PURIFIERS. No. 6129.

Patent Licence.

INCANDESCENT MANTLE MANUFACTURE. Haseltine, Lake, and Co., 28, Southampton Buildings, Chancery Lane, W.C.

Sales of Stocks and Shares.

HAYWARDS HEATH GAS COMPANY. By tender. Jan. 14.

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HARWICH GAS COMPANY. Tenders by Jan. 8.

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No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer—not necessarily for publication, but as a proof of good faith.

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